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USER'S MANUAL

Volume I

Boundary Layer Integral Matrix Procedure

(BLIMP)

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TECHNICAL REPORT NO. AFWL-TR-69-114, Vol I

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AIR FORCE WEAPONS LABORATORY
Air Force Systems Command
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FOREWORD

This report was prepared by the Aerotherm Corporation, Mountain View, California, under Contract F29601-68-C-0062. The research was performed under Program Element 62601F, Project 5791, Task 27.

Inclusive dates of research were March 1968 through October 1969. The report was submitted 11 February 1970 by the Air Force Weapons Laboratory Project Officer, Captain Ronald H. Aungier (WLEE).

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This technical report has been reviewed and is approved.

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ABSTRACT

A complete description of the Boundary Layer Integral Matrix Procedure (BLIMP) computer code is given, including descriptions and explanations of the program input preparation, interpretation of output, special output for debugging purposes, and a list and definitions of the Fortran variables. Three sample problems are included, ranging in complexity from air flow over a flat plate to air flow over an ablating reentry vehicle nosetip and heat shield composed of three different surface materials. A section on changing program dimensions is also included.

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CONTENTS

SECTION I

INTRODUCTION

This report contains a description of the Boundary Layer Integral Matrix Procedure (BLIMP) Fortran V computer program and instructions for using the program. The BLIMP program solves the laminar or turbulent, nonsimilar, multicomponent, equilibrium boundary layer for axisymmetric or planar bodies and for general chemical systems. The theoretical development and computational procedures which form the basis for this computer program are discussed in reference 1. The present report is a revised version of reference 2, which detailed the use of an earlier version of the program. The publication of this new User's Manual was prompted by several improvements in the BLIMP code, the most notable of which is the addition of a model for the analysis of turbulent flows. This turbulent model is discussed in detail in reference 1.

A summary of the types of problems which can be treated is presented in Section II. A comprehensive set of input instructions is presented in Section III which includes descriptions of the various options which are available to the user. The standard output format is described in Section IV. Input and output for several sample cases are presented in Section V. Potential problem areas and a description of special debug output which can be obtained are presented in Section VI. Operating procedures for a CDC 6600 computer system are presented in Section VII, and instructions for changing program dimensions are included in Section VIII. Fortran variables and definitions are given in Section IX.

SECTION II

PROBLEM DESCRIPTION

The BLIMP program uses a strip-integral numerical procedure to solve, with as much accuracy as desired, a comprehensive set of equations describing fluid flow in a boundary layer (reference 1). The equations apply to general, ionized chemical systems in local chemical equilibrium (reference 3). Unequal diffusion and thermal diffusion coefficients for each species can be considered through the use of convenient approximations for these coefficients described in reference 4. Relations of the Sutherland-Wassiljewa type are used for mixture molecular viscosity and conductivity.

For turbulent flows, the time-averaged equations of motion are solved utilizing an eddy viscosity model to describe the "Reynolds stress" term, plus constant turbulent Prandtl and Schmidt numbers in the energy and species conservation equations. Eddy viscosity is related to a variable mixing length in the region very near the wall, and to global parameters of the flow in the outer portion of the boundary layer. Turbulent transport terms in the equations of motion are considered only after the transition criterion, an input transition Reynolds number on momentum thickness, has been satisfied.

The procedure applies to arbitrary planar or axisymmetric, blunt or sharp body geometries. Transverse curvature may be considered for axisymmetric bodies. The boundary-layer edge gas must be adiabatic but it may be nonisentropic. With regard to boundary layer edge conditions, it is necessary for the user to supply only composition of the edge gas, stagnation enthalpy and pressure, and distributions of pressure, entropy (if nonisentropic) and incident radiation flux around the body. The incident radiation is not attenuated in the boundary layer but enters directly into the wall energy balance (when one is performed).

At the wall it is possible to assign temperature and mass fluxes of various component gas mixtures defined by the user, to require the surface to be in equilibrium with whatever condensed species is predicted by the program to be the surface species, to permit rate-controlled surface reactions specified by the user, and to perform a steady state energy balance at the wall (in which case the boundary layer is completely coupled to the wall response). A candidate surface species can be considered to be removed mechanically in the event it wants to appear as the surface above a "fail temperature" prescribed by the user (e.g., the fail temperature for silica might be selected as its melt temperature). Such boundary conditions as mass addition, ablation material, and body shape can be varied discontinuously around the body, and the type of wall boundary condition can be altered in different regions over the body.

SECTION III

INPUT

The BLIMP program uses punched cards as the input media. Formatted read statements are used throughout. A comprehensive set of input instructions comprises the bulk of this section. Input data for several sample problems are presented in Section V.

The input instructions presented herein are annotated by discussions of program options, appropriate units, procedures for avoiding convergence problems and other information to help the user in his decision making and to present to him the full potential of the program. Unfortunately, this has the effect of making the input appear much more complex than it really is. Actually, the BLIMP program is quite simple and straightforward to use considering the complexity of the problems which it can treat and the large number of options it contains. It is recommended that the user review the entire set of instructions each time he formulates a problem for at least the first several dozen submittals. After this, it may be convenient for the user to prepare his own abbreviated set of user instructions for those options of primary interest to him.

GROUP 1 CONTROL CARD, TITLE, AND IDENTIFICATION (CALLED FROM RECASE)

CARD 1,FORMAT(20I1,15A4),KR

FIELD 1 (COLUMNS 1-20) THIS IS THE VARIABLE KR(DIMENSIONED 20) WHICH IS USED TO CONTROL THE VARIOUS PROGRAM OPTIONS

COLUMN 1 DETERMINES WHETHER A NEW SET OF ETA VALUES IS TO BE INPUT FOR PRESENT CASE (SEE GROUP 4)

0 USES RESIDENT VALUES FROM PREVIOUS CASE

1 VALUES INPUT BY USER (MANDATORY FOR FIRST CASE)

COLUMN 2 DESIGNATES TYPE OF FIRST GUESSES TO BE UTILIZED FOR PRIMARY VARIABLES (SEE GROUP 9)

0 USES BUILT-IN RELATIONS TO CALCULATE FIRST GUESSES (REQUIRES READING ONLY GUESS FOR ENTHALPY OF THE GAS AT THE WALL). RECOMMENDED FOR MOST SITUATIONS.

1 FIRST GUESSES INPUT BY USER

2 USES RESIDENT VALUES FROM PREVIOUS CASE (CANNOT BE USED FOR FIRST CASE OR WHEN COMPOSITION OF EDGE GAS IS DIFFERENT FROM PREVIOUS CASE)

3 FIRST GUESSES INPUT BY USER ARE ACCEPTED AS SOLUTION AT FIRST TIME AND FIRST OR SUBSEQUENT (FOR RESTART) STATION.

COLUMN 3 DETERMINES TREATMENT OF STREAMWISE DERIVATIVES. SEE REFERENCE 1, SECTION III FOR EXPLANATION OF DIFFERENCE RELATIONS.

0 PERFORMS SIMILAR SOLUTION AT EACH STREAMWISE STATION

1 CONSIDERS TWO-POINT DIFFERENCE RELATIONS AT ALL STATIONS WITH THE FOLLOWING EXCEPTIONS (A SIMILAR SOLUTION IS PERFORMED AT THE FIRST STATION FOR NON-BLUNT BODIES AND AT THE FIRST TWO STATIONS FOR BLUNT BODIES)

2 CONSIDERS THREE POINT DIFFERENCE RELATIONS AT ALL STATIONS WITH THE FOLLOWING EXCEPTIONS (A SIMILAR SOLUTION IS PERFORMED AT THE FIRST STATION AND A TWO-POINT SOLUTION IS PERFORMED AT THE SECOND STATION FOR NON-BLUNT BODIES, SIMILAR SOLUTIONS ARE PERFORMED AT THE FIRST AND SECOND STATIONS AND A TWO-POINT SOLUTION IS PERFORMED AT THE THIRD STATION FOR BLUNT BODIES, AND A TWO-POINT SOLUTION IS PERFORMED FOR THE FIRST STATION AFTER A DISCONTINUITY - SEE CARD SET 4 OF GROUP 3)

COLUMN 4 DETERMINES WHEN OUTPUT BLOCK IS TO BE PRINTED

0 OUTPUT BLOCK PRINTED FOR CONVERGED SOLUTION OR FOR NONCONVERGED SOLUTION AFTER 50 ITERATIONS (WITH APPROPRIATE COMMENT)

1 OUTPUT BLOCK PRINTED AFTER EACH ITERATION

COLUMN 5 DETERMINES TREATMENT OF ENTROPY LAYER

0 NOT USED

1 NOT USED

2 NOT USED

3 NOT USED

4 AN ISENTROPIC EXPANSION AROUND THE BODY IS PERFORMED (IN THE CASE OF A BLUNT BODY, THE ENTROPY CORRESPONDS TO THAT BEHIND A NORMAL SHOCK)

5 A NONISENTROPIC EXPANSION AROUND THE BODY IS PERFORMED, THE USER SUPPLYING ENTROPY CHANGES BETWEEN STREAMWISE STATIONS (THIS IS A ZEROTH APPROXIMATION TO AN ENTROPY LAYER, THE VELOCITY GRADIENT AT THE BOUNDARY LAYER EDGE BEING NEGLECTED - SEE CARD SET 1 AND CARD 2 OF GROUP 15), KR(7)=0 OR 2 ONLY.

COLUMN 6 DESIGNATES BODY SHAPE (IN THE CASE OF AXISYMMETRIC SHARP BODIES AND AXISYMMETRIC AND PLANAR BLUNT BODIES, A TRANSFORMATION OF STREAMWISE DISTANCE, S, TO S**3, S**4, AND S**2, RESPECTIVELY, IS UTILIZED TO PERFORM STREAMWISE INTEGRATIONS IN ORDER TO TAKE ADVANTAGE OF THE WAY THAT EDGE VELOCITY AND LOCAL BODY RADIUS VARY WITH S IN THE VICINITY OF THE TIP OR STAGNATION REGION. THEREFORE, A 4 OR 9 IN COL. 6 IS REQUIRED IF THE SOLUTION DOES NOT START FROM A SHARP TIP OR STAGNATION POINT. FURTHERMORE, IN THE CASE OF SHARP OR BLUNT BODIES, A DISCONTINUITY INTRODUCED AT A DOWNSTREAM STATION REVERTS TO INTEGRATION WITH RESPECT TO S STARTING AT THAT STATION. IT IS RECOMMENDED THAT THIS BE DONE AFTER AN APPRECIABLE CHANGE OF SURFACE INCLINATION WITH RESPECT TO THE FREE-STREAM VELOCITY FROM THAT AT THE TIP OR STAGNATION POINT. THE OPTIMUM SWITCH-OVER POINT DEPENDS ON THE SPECIFIC BODY SHAPE. IT IS LEFT TO THE USER TO ESTABLISH THIS FOR THE BODY SHAPE OF INTEREST. THE METHOD FOR IMPLEMENTING A DISCONTINUITY IS DISCUSSED UNDER CARD SET 4 OF GROUP 3).

0 AXISYMMETRIC BLUNT BODY

1 PLANAR BLUNT BODY

2 AXISYMMETRIC SHARP BODY

3 PLANAR SHARP BODY

4 AXISYMMETRIC OR PLANAR SHAPE WHICH HAS NO SHARP TIP OR BLUNT STAGNATION POINT, FOR EXAMPLE, A NOZZLE

5 AXISYMMETRIC BLUNT BODY WITH TRANSVERSE CURVATURE

6 NOT USED

7 AXISYMMETRIC SHARP BODY WITH TRANSVERSE CURVATURE

8 AXISYMMETRIC SHAPE WITH INTERNAL FLOW AND TRANSVERSE CURVATURE

9 EXTERNAL FLOW OVER AXISYMMETRIC SHAPE WHICH HAS NO SHARP TIP OR BLUNT STAGNATION POINT AND WITH TRANSVERSE CURVATURE

COLUMN 7 DESIGNATES WHETHER OR NOT TURBULENT FLOW WILL BE CONSIDERED.

0 LAMINAR FLOW ONLY

1 NOT USED IN PRESENT VERSION OF PROGRAM

2 TURBULENT FLOW WILL BE COMPUTED IF TRANSITION CRITERIA IS EXCEEDED (SEE GROUP 8).

COLUMN 8 DESIGNATES FORM IN WHICH WALL MASS FLUXES ARE INPUT. (KR(8) IS NOT UTILIZED IF WALL FLUXES ARE NOT INPUT. THE FLUX NORMALIZING PARAMETER IS NOT GENERALLY KNOWN IN ADVANCE SO KR(8)=0 IS NORMALLY USED WHEN FLUXES ARE INPUT). UTILIZED IN CARD SETS 7 AND 11 IN GROUPS 16, 17, 18, ...

0 WALL FLUXES INPUT IN LBS/SEC FT**2

1 WALL FLUXES INPUT IN NORMALIZED FORM (I.E., DIVIDED BY -ALPHASTAR, SEE EQUATION 44 OF NASA CR-1062)

COLUMN 9 TOGETHER WITH COLUMN 11, THIS SPECIFIES THE TYPE OF WALL BOUNDARY CONDITIONS. THE USER IS URGED TO FAMILIARIZE HIMSELF WITH THE DISCUSSION IN APPENDIX I BEFORE CHOOSING THESE OPTIONS.

0 NOT GENERALLY USED. ASSIGNED ELEMENTAL MASS FRACTIONS AND STREAM FUNCTION AT THE WALL (REQUIRES KR(11) = 0 OR 1).

1 NOT GENERALLY USED. ASSIGNED ELEMENTAL MASS FRACTIONS AND TOTAL MASS FLUX AT THE WALL (REQUIRES KR(11) = 0 OR 1).

2 ASSIGNED COMPONENT MASS FLUXES AT THE WALL (MDOT EDGE GAS, MDOT PYROLYSIS GAS, MDOT CHAR-- REQUIRES KR(11) = 0, 1, OR 2).

3 NOT USED

4 WALL STEADY STATE ENERGY BALANCE WHILE SATISFYING WALL MASS BALANCES AND LIMITED SURFACE EQUILIBRIUM (USE KR(11) = 0, KR(7) = 0 OR 2.

COLUMN 10 DETERMINES TYPE OF CURVE FITS EMPLOYED TO REPRESENT THE PRIMARY VARIABLES OF VELOCITY RATIO, TOTAL ENTHALPY, AND ELEMENTAL MASS FRACTIONS (KR(10)=0 IS RECOMMENDED FOR ACCURACY FOR MOST PROBLEMS, HOWEVER, KR(10)=1 IS BETTER FOR SEVERE PROBLEMS (E.G., NEARLY BLOWN OFF BOUNDARY LAYERS) FOR WHICH CUBICS CAN BECOME POORLY BEHAVED)

0 UTILIZES CONNECTED CUBICS

1 UTILIZES CONNECTED QUADRATICS EXCEPT FOR OUTERMOST SEGMENT WHERE CONNECTED CUBICS ARE EMPLOYED

2 UTILIZES CONNECTED QUADRATICS EVERYWHERE.

3 SAME AS 2 BUT DEMANDS ZERO VELOCITY GRADIENT AT THE OUTER EDGE OF THE BOUNDARY LAYER (OVERRIDES THE ALPHA CONSTRAINT - SEE GROUP 4, CARD 3).

COLUMN 11 TOGETHER WITH COLUMN 9, THIS DESIGNATES THE TYPE OF WALL BOUNDARY CONDITION (SEE APPENDIX I). SEE GROUPS 16, 17, 18,...

0 ASSIGNED WALL TEMPERATURE. ALSO USED WITH KR(9)=4. THIS OPTION TOGETHER WITH KR(9)=2 WILL YIELD SURFACE EQUILIBRIUM OR KINETIC SURFACE SOLUTION IF THE ASSIGNED TEMPERATURE IS GREATER THAN THE ASSIGNED ABLATION TEMPERATURE (SEE GROUP 11, CARD 1, FIELD 7). THE PROGRAM WILL CALCULATE THE APPROPRIATE CHAR FLUX. ASSIGNED CHAR FLUX SHOULD BE SET TO ZERO (SEE GROUP 16, CARD SET 11).

1 ASSIGNED WALL ENTHALPY.

2 SURFACE EQUILIBRIUM WITH ASSIGNED COMPONENT MASS FLUXES (REQUIRES KR(9) = 2). THE PROBLEM IS WELL-POSED AND WILL CONVERGE ONLY IF THERE EXISTS A TEMPERATURE ABOVE 250K GIVING SURFACE EQUILIBRIUM FOR THE ASSIGNED COMPONENT MASS FLUXES. USE WITH CAUTION FOR ANALYSES OF MATERIALS WITH PLATEAU-LIKE BEHAVIOR.

3 CABLE SOLUTIONS ONLY. ASSIGNED WALL TEMPERATURE.

4 CABLE SOLUTIONS ONLY. SURFACE EQUILIBRIUM.

COLUMN 12 DETERMINES WHETHER OR NOT NEW DATA FOR THERMODYNAMIC AND TRANSPORT PROPERTIES ARE TO BE USED AND WHETHER OR NOT SURFACE KINETIC DATA ARE TO BE CONSIDERED (SEE GROUPS 11, 12,13, AND 14). APPLIES ONLY FOR KR(7)=0 OR 2. (KR(12) MUST BE 0, 2, 5, OR 7 FOR FIRST CASE). IN THE FOLLOWING, X=5 FOR KINETIC DATA AND X=0 FOR NO KINETIC DATA.

X USER INPUTS NEW DATA FOR ELEMENTS AND MOLECULAR, ATOMIC, AND IONIC SPECIES. THERMOCHEMICAL DATA NOT PRINTED IN OUTPUT.

1+X USES RESIDENT ELEMENTAL AND SPECIES DATA.

2+X SAME AS KR(12)=X EXCEPT THERMOCHEMICAL DATA ARE PRINTED IN OUTPUT. (WHEN X=5 KINETIC DATA ALWAYS PRINTED IN OUTPUT).

COLUMN 13 PERMITS THE ASSIGNMENT OF A CONVERGENCE DAMPING FACTOR (THIS IS OVERRIDDEN IF A SMALLER DAMPING FACTOR IS COMPUTED INTERNALLY BY SOME CONSTRAINT)

0 NO DAMPING FACTOR IS ASSIGNED

J IF J IS GREATER THAN ZERO, CORRECTIONS ARE DAMPED UNIFORMLY BY J/10 THIS PROCEDURE IS NOT RECOMMENDED AS IT IS VERY INEFFICIENT AND THE DAMPING COMPUTED BY THE PROGRAM IS USUALLY ADEQUATE

COLUMN 14 DETERMINES MODEL TO BE EMPLOYED FOR MULTICOMPONENT TRANSPORT PROPERTIES. APPLIES ONLY FOR KR(7) = 0 OR 2. CONSIDERING UNEQUAL DIFFUSION COEFFICIENTS CAN SUBSTANTIALLY INCREASE THE NUMBER OF ITERATIONS (AND SOMETIMES CONVERGENCE DOES NOT OCCUR IN THE ALLOWED NUMBER OF ITERATIONS) DUE TO THE USE OF INEXACT DERIVATIVES IN THE NEWTON-RAPHSON ITERATION PROCEDURE

0 CONSIDERS UNEQUAL DIFFUSION AND THERMAL DIFFUSION COEFFICIENTS FOR ALL SPECIES

1 CONSIDERS UNEQUAL DIFFUSION COEFFICIENTS FOR ALL SPECIES BUT NEGLECTS THERMAL DIFFUSION

2 CONSIDERS EQUAL DIFFUSION COEFFICIENTS AND NEGLECTS THERMAL DIFFUSION

COLUMN 15 NON-ZERO ENTRY PROVIDES DEBUG OUTPUT FOR FIRST GUESSES AND LINEAR MATRICES (SEE DEBUG INSTRUCTIONS FOR MORE DETAILED INFORMATION ON COLUMNS 15 THROUGH 20)

0 NO DEBUG

1 FIRST GUESSES ARE DUMPED

2 LINEAR MATRICES BEFORE AND AFTER INVERSION ARE ALSO DUMPED

COLUMN 16 NON-ZERO ENTRY PROVIDES DEBUG OUTPUT FOR WALL FLUXES AND SURFACE EQUILIBRIUM ITERATION (SOME OF THE TESTS ARE ACTUALLY MADE ON KR(7), SEE DEBUG INSTRUCTIONS)

0 NO DEBUG

X FOR X GREATER THAN ZERO, THE DERIVATIVES OF WALL ENERGY AND MASS FLUXES WITH RESPECT TO REDUCED NONLINEAR VARIABLES (DQJRNL), AND THE ASSOCIATED ERRORS (WALLQJ AND DELQJW) ARE DUMPED. ALSO, THE MATRIX OF WALL RELATIONS BEFORE AND AFTER MATRIX INVERSION IS DUMPED FOR KR(11)=2 PROBLEMS.

Y FOR Y GREATER THAN UNITY, SURFACE EQUILIBRIUM ITERATION INFORMATION IS ALSO DUMPED (AS IN KR(18)) AND IF KR(17) IS GREATER THAN ZERO, THE DERIVATIVES OF WALL ENERGY AND MASS FLUXES WITH RESPECT TO ALL NONLINEAR VARIABLES (DQUNL) ARE ALSO DUMPED.

COLUMN 17 NON-ZERO ENTRY PROVIDES DEBUG OUTPUT FOR COEFFICIENTS IN NON-LINEAR EQUATIONS AND FOR STREAMWISE DERIVATIVES

0 NO DEBUG

X FOR X GREATER THAN ZERO, STREAMWISE DERIVATIVE INFORMATION IS DUMPED.

Y FOR (Y+1-ITS) GREATER THAN ZERO, WHERE ITS IS THE NUMBER OF THE CURRENT BOUNDARY LAYER ITERATION, THE COEFFICIENTS WHICH COMBINE TO MAKE UP THE NONLINEAR EQUATIONS (COEEQV ARRAY) AND CERTAIN LINEAR AND NONLINEAR ERROR INFORMATION ARE DUMPED AND THE DERIVATIVES OF THE NONLINEAR EQUATIONS WITH RESPECT TO THE NONLINEAR VARIABLES (AM ARRAY) ARE DUMPED BEFORE AND AFTER INVERSION.

COLUMN 18 NON-ZERO ENTRY PROVIDES DEBUG OUTPUT FOR CHEMISTRY ITERATION (KR(7) = 0 OR 2 ONLY). (THE TESTS ARE ACTUALLY MADE ON KR(7). SEE DEBUG INSTRUCTIONS).

0 NO DEBUG

1 DUMPS CHEMISTRY ITERATIONS IN DETAIL FOR ITS GREATER THAN 45 WHERE ITS IS THE COUNTER ON CHEMISTRY ITERATIONS

2 DUMPS ONE LINE PER ITERATION DURING EACH CHEMISTRY ITERATION

Y FOR Y OF 3 THROUGH 6, DUMPS CHEMISTRY ITERATIONS IN DETAIL WHEN (5*(Y-2)-ITS) IS GREATER THAN ZERO.

X FOR X OF 7 THROUGH 9, DUMPS CHEMISTRY ITERATIONS IN DETAIL WHEN ITS IS GREATER THAN 10X-50.

COLUMN 19 NON-ZERO ENTRY PROVIDES DEBUG OUTPUT FOR LINEAR AND NONLINEAR ERRORS

0 NO DEBUG

1 DUMPS (FOR EACH ITERATION) THE FOLLOWING. ERRORS FOR NONLINEAR MOMENTUM (FNLE), ENERGY (GNLE), AND SPECIES (SPNLE) EQUATIONS, ERRORS (DRNL) AND COEFFICIENTS (DVNL) FOR NONLINEAR WALL BOUNDARY CONDITIONS, AND ERRORS FOR TAYLOR SERIES EXPANSIONS AND LINEAR BOUNDARY CONDITIONS FOR F AND ITS DERIVATIVES (FLE), ENTHALPY AND ITS DERIVATIVES (GLE), AND ELEMENTAL MASS FRACTIONS AND THEIR DER-IVATIVES (SPLE).

COLUMN 20 NON-ZERO ENTRY PROVIDES DEBUG OUTPUT FOR THERMODYNAMIC AND TRANSPORT PROPERTIES (KR(7) = 0 OR 2 ONLY).

0 NO DEBUG

X FOR X GREATER THAN ZERO, GIVES THERMODYNAMIC AND TRANSPORT PROPERTY INFORMATION FOR EACH CHEMISTRY SOLUTION

2 GIVES MATRIX OF PROPERTY DERIVATIVES BEFORE AND AFTER INVERSION

FIELD 2 (COLUMNS 21-80), CASE

TITLE OF CASE (ALPHANUMERIC). USED FOR IDENTIFICATION OF PRINTED OUTPUT)

CARD 2

INSERT A BLANK CARD HERE

GROUP 2 NUMBER OF ELEMENTS (CALLED FROM RECASE)

CARD 1, FORMAT(I2,8X,40I1)

FIELD 1 (COLUMNS 1-2, RIGHT-JUSTIFIED), NSP

NUMBER OF ELEMENTS IN THE SYSTEM NOT INCLUDING ELECTRONS (MAX. OF 9)

FIELDS 2-51 (COLUMNS (11-60), KS(M), M=1,NS ***** USED ONLY FOR KR(9) OR ANY OF THE KR9 = 3 OR 4 *****

THE SURFACE MATERIAL IS SPECIFIED IN ADVANCE BY THE USER FOR KR(9) = 3 OR 4. UP TO THREE MATERIAL COMBINATIONS ARE ALLOWED. EACH COMBINATION MAY HAVE A SEPARATE PYROLYSIS GAS AND CHAR MATERIAL SPECIFIED IN GROUP 11, FIELD 5. ENTER A 1, 2, OR 3 TO DENOTE MATERIAL COMBINATION 1, 2, OR 3 STARTING WITH THE STATION 1 ENTRY IN COLUMN 11, STATION 2 IN COLUMN 12, ETC. SEE ALSO GROUP 6, CARDS 1 AND 2.

GROUP 3 TIMES AND STATIONS (CALLED FROM RECASE)

CARD 1, FORMAT(I2)

FIELD 1 (COLUMNS 1-2, RIGHT-JUSTIFIED), NITEM

NUMBER OF TIMES (OR SUBCASES) BEING CONSIDERED IN PRESENT CASE. (MAXIMUM OF 50). A SERIES OF PROBLEMS CAN BE CONSIDERED AS A SEQUENCE OF TIMES (OR SUBCASES) IN THE SAME CASE AS LONG AS THE FOLLOWING ARE UNCHANGED, NUMBER OF ELEMENTS (GROUP 2), STREAMWISE STATIONS (CARD 3 AND CARD SET 4 OF THIS GROUP), NODAL SPACING (GROUP 4), BODY SHAPE (GROUP 5), AND ELEMENTAL AND SPECIES DATA (GROUP 10 OR 11 THRU 14) (AND THUS EDGE GAS AND WALL MATERIAL). CALCULATIONS ARE PERFORMED FOR ALL TIMES AT A GIVEN STATION BEFORE PROCEEDING TO NEXT STATION AND THUS APPEAR IN THIS ORDER IN THE PRINTED AND PUNCHED CARD OUTPUT.

CARD SET 2, FORMAT(8E10.4)

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD,
TIME(M), M=1,NITEM (SEE CARD 1 OF THIS GROUP)

TIME, SEC. THIS VARIABLE SERVES ONLY TO IDENTIFY SOLUTIONS SINCE TIME DOES NOT ENTER INTO THE SOLUTION OF THE PROBLEM. USE A NEGATIVE ENTRY FOR TIME(1) IF IT IS DESIRED THAT THESE IDENTIFICATION NUMBERS BE CALLED CASES IN THE OUTPUT FORMAT (OTHERWISE, THEY ARE IDENTIFIED AS TIMES).

CARD 3, FORMAT(I2,8X,40I1)

FIELD 1 (COLUMNS 1-2, RIGHT-JUSTIFIED), NS

NUMBER OF STREAMWISE STATIONS (MAXIMUM OF 40)

FIELD 2 (COLUMNS 11-50), KR9

VALUES TO BE ASSIGNED TO KR(9) WHEN WALL BOUNDARY CONDITIONS ARE TO BE CHANGED AT DOWNSTREAM STATIONS (SEE CARD 1 OF GROUP 1). COLUMN 11 CORRESPONDS TO STATION S(1), COLUMN 12 TO STATION S(2), AND SO ON. IF WALL BOUNDARY CONDITIONS ARE NOT TO BE CHANGED AT DOWNSTREAM STATIONS, THIS FIELD SHOULD BE LEFT BLANK. WHEN THE KR9( ) ARE EMPLOYED, KR(9) SHOULD BE GIVEN THE SAME VALUE AS KR9(1) EXCEPT WHEN USING THE TRANSPIRATION OPTION DESCRIBED IN APPENDIX I OF THIS MANUAL. AT THE PRESENT TIME, IT IS POSSIBLE TO CONSIDER ANY COMBINATIONS OF KR9 OF 2, 3, AND 4 COMPRISING REGIONS OF AN ABLATION MATERIAL AND REGIONS WHERE THERE IS NO ABLATION (THESE NONABLATING REGIONS ARE OBTAINED BY USE OF KR9( ) = 2 WHILE ASSIGNING ZERO COMPONENT MASS FLUXES, SEE CARD SET 11 OF GROUP 16)

CARD SET 4, FORMAT(8E10.4)

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD,
S(L), L=1,NS (SEE CARD 3 OF THIS GROUP)

STREAMWISE DISTANCE UPON WHICH BOUNDARY-LAYER SOLUTION IS BASED, FEET. A BLUNT-BODY PROBLEM (KR(6) = 0,1 OR 5) SHOULD START WITH AN S(1) OF 0. A SHARP-BODY PROBELM (KR(6) = 2,3 OR 7) OR A NOZZLE-TYPE PROBLEM (KR(6)= 4 OR 8) MUST NOT START WITH A S(1) OF 0. BUT MUST START WITH SOME FINITE DISTANCE. THE BOUNDARY LAYER IS ASSUMED TO BE SIMILAR UP TO AND INCLUDING THIS FIRST STATION. A NEGATIVE ENTRY FOR S(L) SIGNIFIES A DISCONTINUITY AT THAT STATION. THIS PRODUCES A TWO-POINT DIFFERENCE SOLUTION AT THE FIRST STATION AFTER THE DISCONTINUITY AND THUS HAS AN EFFECT ONLY FOR THREE-POINT SOLUTIONS (KR(3)=2), ALSO, FOR BLUNT BODIES, A MINUS SIGN AT A STATION CAUSES STREAMWISE INTEGRATIONS TO REVERT TO S AS THE INDEPENDENT VARIABLE - SEE DISCUSSION UNDER CARD 1, COLUMN 6 OF GROUP 1.

GROUP 4 NODAL DATA (CALLED FROM RECASE) *** SKIP THIS GROUP FOR KR(1)=0 ***

CARD 1, FORMAT(I2) ***** USED ONLY IF KR(1)=1 *****

FIELD 1 (COLUMNS 1-2, RIGHT-JUSTIFIED), NETA

NUMBER OF NODAL POINTS ACROSS THE BOUNDARY LAYER INCLUDING WALL AND BOUNDARY LAYER EDGE (MAXIMUM OF 15).

CARD SET 2, FORMAT(8E10.4) ***** USED ONLY IF KR(1)=1 *****

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD,
ETA(I), I=1,NETA (SEE CARD 1 OF THIS GROUP)

ETA STATIONS ACROSS THE BOUNDARY LAYER, STARTING AT WALL (ETA=0.0). IT IS RECOMMENDED THAT THE VALUE OF ETA AT THE BOUNDARY-LAYER EDGE BE GIVEN A VALUE OF ABOUT 5.0 SO THAT THE STRETCHING PARAMETER WILL BE NEAR UNITY. ALSO, THERE SHOULD NOT BE MUCH MORE THAN A TWO-FOLD CHANGE IN DISTANCE BETWEEN TWO NEIGHBORING NODES. BEST ACCURACY FOR A GIVEN NUMBER OF NODES IS OBTAINED IF THE NODES ARE CLOSER TOGETHER NEAR THE WALL. FOR LAMINAR PROBLEMS, 7 NODES ARE OFTEN SUFFICIENT WITH A TYPICAL SPACING BEING 0.0, 0.5, 1.0, 1.5, 2.0, 3.0, 5.0 AND WITH KAPPA = 5, CBAR = 0.8 (SEE CARD 3, FIELDS 1 AND 2 OF THIS GROUP). FOR TURBULENT BOUNDARY LAYERS, MORE NODES ARE NEEDED CLOSE TO THE WALL DUE TO THE STEEP GRADIENTS THERE. A TYPICAL SPACING WOULD BE 0.0, 0.024, 0.040, 0.072, 0.120, 0.200, 0.320, 0.480, 0.800, 1.400, 2.000, 3.200, 5.000, WITH KAPPA = 11 AND CBAR = 0.95. WHATEVER THE NODE SPACING THE USER MUST EXAMINE THE SOLUTIONS TO BE SURE THAT A REASONABLE CURVEFIT IS OBTAINED NEAR THE WALL. THIS CAN BE A PROBLEM FOR LARGE STREAMWISE DISTANCES IN TURBULENT FLOWS.

CARD 3, FORMAT(I2,E10.4) ***** USED ONLY IF KR(1)=1 *****

FIELD 1 (COLUMNS 1-2, RIGHT-JUSTIFIED), KAPPA

THE VARIABLE KAPPA IS ASSOCIATED WITH THE CONSTRAINT WHICH IS UTILIZED TO EFFECT A STRETCHING OF ETA, THE BOUNDARY-LAYER COORDINATE NORMAL TO THE SURFACE, IN ORDER TO EFFECTIVELY USE THE ASSIGNED NODAL SPACING (SEE CARDS 1 AND 2 OF THIS GROUP). KAPPA IS THE INDEX FOR THE NODAL POINT AT WHICH THE VELOCITY RATIO IS FIXED. TO ILLUSTRATE, IF KAPPA IS 5, THEN THE FIFTH NODAL POINT COUNTING FROM THE WALL AND INCLUDING THE WALL WILL HAVE A VALUE OF CBAR (A QUANTITY WHICH IS INPUT IN THE SECOND FIELD OF THIS CARD).

FIELD 2 (COLUMNS 3-12), CBAR

CBAR IS THE VALUE OF THE VELOCITY RATIO AT THE BOUNDARY-LAYER NODE DESIGNATED KAPPA (SEE DISCUSSION UNDER FIELD 1 OF THIS CARD)

GROUP 5 BODY SHAPE DATA (CALLED FROM RECASE)

CARD 1, FORMAT(2E10.4) ***** USED ONLY IF BLUNT BODY, KR(6)=0,1, OR 5 *****

FIELD 1 (COLUMNS 1-10), CONE

CONE HALF-ANGLE IN SPHERE-CONE SHAPE BODIES, LEAVE BLANK FOR OTHER BODY SHAPES.

FIELD 2 (COLUMNS 11-20), RNOSE

EFFECTIVE NOSE RADIUS, FEET. THE VALUE READ INTO THIS FIELD IS OVER-RIDDEN IF THE PRESSURE RATIO AT THE FIRST STATION, PRE(1), IS READ IN AS A ZERO (SEE CARD SET 3 OF GROUP 15). IF PRE(1) IS NON-ZERO, THEN A NON-ZERO ENTRY IN THE CURRENT FIELD IS USED IN THE CALCULATION OF STAGNATION POINT VELOCITY GRADIENT FROM THE NEWTONIAN RELATION

DUES = SQRT(2./RHOE * PE * 32.1740 * 2116.) / RNOSE

WHERE DUES IS THE STAGNATION POINT VELOCITY GRADIENT AND RHOE AND PE ARE LOCAL STAGNATION DENSITY (LB/FT3) AND PRESSURE (ATM), RESPECTIVELY. THIS LATTER APPROACH IS REQUIRED FOR BLUNT-BODY PROBLEMS IF THERE IS ONLY ONE STATION (NS = 1, SEE CARD 3 OF GROUP 3). WHEN RNOSE IS READ INTO THE CURRENT FIELD AND NOT BEING OVERRIDDEN (I.E., WHEN PRE(1) IS NOT SET EQUAL TO ZERO) A MACH NUMBER CORRECTION (IMPORTANT FOR LOW FREE-STREAM MACH NUMBERS) CAN BE MADE BY INPUTTING

RNOSE = REFF / SQRT(1. - PINF / PE)

WHERE REFF IS THE TRUE EFFECTIVE NOSE RADIUS (FEET) AND PINF IS THE FREE STREAM STATIC PRESSURE (LB/FT2). (IF THE CURRENT FIELD IS LEFT BLANK AND PRE(1) IS NON-ZERO, THE STAGNATION-POINT VELOCITY GRADIENT IS COMPUTED FROM A CURVE FIT OF THE PRE AROUND THE BODY. IN ANY EVENT, A CURVE FIT OF PRESSURE IS USED TO COMPUTE VELOCITY GRADIENT FOR STATIONS 2 AND BEYOND).

CARD SET 2, FORMAT(8E10.4) ***** NOT USED IF KR(6)=1 OR 3 *****

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD, ROKAP(L), L=1, NS (SEE CARD 3 OF GROUP 3)

THIS IS THE LOCAL BODY RADIUS IN FEET NORMAL TO THE BODY CENTERLINE RAISED TO THE KAPPA POWER WHERE KAPPA IS UNITY FOR AXISYMMETRIC BODIES AND ZERO FOR PLANAR BODIES. THEREFORE, ROKAP IS UNITY FOR PLANAR BODIES AND LOCAL BODY RADIUS FOR AXISYMMETRIC BODIES. FOR PLANAR BODIES, THIS CARD SET IS USED ONLY IF KR(6) = 4. TWO SPECIAL INPUT FORMATS CAN BE USED. FOR SPHERE CONE BODIES, SET ROKAP(1) EQUAL TO MINUS THE NOSE RADIUS. THE NOSE RADIUS IS THEN SET TO -ROKAP(1) AND ROKAP(1) IS SET TO ZERO. IF SUBSEQUENT ROKAP( ) ARE INPUT AS ZEROES, THE PROGRAM COMPUTES ROKAP FROM S FOR A SPHERICAL NOSE. THE FIRST NONZERO ENTRY IS THE ROKAP AT THE CONE TANGENT POINT. IF THIS IS AGAIN FOLLOWED BY ZEROES, LINEAR INTERPOLATION IS USED TO THE NEXT NONZERO ENTRY TO YIELD ROKAP ALONG A CONICAL AFTERBODY.

FOR SHARP CONES, KR(6) = 2 OR 7, SET ROKAP(1) EQUAL TO MINUS THE CONE HALF ANGLE IN DEGREES. ROKAP(1) IS THEN SET TO ZERO AND THE PROGRAM COMPUTES ROKAP FROM S FOR A SHARP CONE OF THE SPECIFIED HALF ANGLE.

GROUP 6 MATERIAL PROPERTY DATA NEEDED FOR WALL QUASI-STEADY ENERGY BALANCE (CALLED FROM RECASE) *****CONSIDER THIS GROUP ONLY IF KR(9) OR ANY OF THE KR9 IS EQUAL TO 3 OR GREATER*****

CARD 1, FORMAT(9E8.3) ** USED ONLY IF KR(9) OR ANY OF THE KR9 IS 3 OR 4 **

FIELDS 1,4,7 (COLUMNS 1-8, 25-32, 49-56), EMIV(I),I=1,3

SURFACE EMITTANCE OF THE MATERIAL COMBINATIONS BEING CONSIDERED UNDER KR(9) OR KR9 OF 3 OR 4.

FIELDS 2,5,8 (COLUMNS 9-16, 33-40, 57-64), HCARB(I),I=1,3

HEAT OF FORMATION (BTU/LB) OF THE VIRGIN STATE OF THE ABLATION MATERIALS BEING CONSIDERED UNDER KR(9) OR KR9 OF 3 OR 4.

FIELDS 3,6,9 (COLUMNS 17-24, 41-48, 65-72), HPG(I),I=1,3

HEAT OF FORMATION (BTU/LB) OF THE TRANSPIRANTS BEING CONSIDERED UNDER KR(9) OR KR9 OF 3 OR 4.

CARD 2, FORMAT(6A4) ** USED ONLY WITH CARD 1 **

FIELDS 1,2, AND 3 (COLUMNS 1-8, 9-16, 17-24)

NAMES OF SURFACE SPECIES FOR MATERIAL COMBINATIONS 1,2, AND 3 EXACTLY AS THEY APPEAR IN THE THERMODYNAMIC DATA TABLES (GROUP 13), LEFT JUSTIFIED.

GROUP 7 FUNCTION-OF-TIME DATA (CALLED FROM RECASE)

CARD SET 1, FORMAT(8E10.4)

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD,
PTET(M), M=1,NITEM (SEE CARD 1 OF GROUP 3)

LOCAL STAGNATION PRESSURE FOR EACH TIME BEING CONSIDERED, ATMOSPHERES

CARD SET 2, FORMAT(8E10.4)

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD,
GE(M), M=1,NITEM (SEE CARD 1 OF GROUP 3)

STAGNATION ENTHALPY FOR EACH TIME BEING CONSIDERED, BTU/LB

CARD SET 3, FORMAT(8E10.4)

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD,
RADFL(M), M=1,NITEM (SEE CARD 1 OF GROUP 3)

INCIDENT RADIATION FLUX ABSORBED BY THE SURFACE AT STATION S(1) FOR EACH TIME BEING CONSIDERED, BTU/SEC FT2 (IF A SURFACE ABSORPTIVITY LESS THAN UNITY IS TO BE CONSIDERED, THESE ENTRIES SHOULD BE CORRECTED FOR SURFACE ABSORPTIVITY). THIS INFORMATION IS USED ONLY FOR KR(9) OR KR9 OF 4 OR 6. INPUT BLANKS IN THIS FIELD FOR OTHER TYPES OF PROBLEMS. RADIATION FLUX AT OTHER STATIONS WILL BE INPUT AS RATIOS IN GROUP 15.

GROUP 8 TURBULENT FLOW PARAMETERS (CALLED FROM TREMBL) **** CONSIDER THIS GROUP ONLY IF KR(7)=2 OR 3 ****

CARD 1, FORMAT(6E10.3)

FIELDS 1-6, (COLUMNS 1-10, 11-20, 21-30, 31-40, 41-50, 51-60) ELCON, YAP, CLNUM, SCT, PRT, RETR

ELCON IS THE PRANDTL MIXING LENGTH CONSTANT (0.44 IS A TYPICAL VALUE).

YAP IS A CONSTANT OF PROPORTIONALITY IN THE MIXING LENGTH EXPRESSION (11.823 IS A TYPICAL VALUE).

CLNUM IS THE CLAUSER CONSTANT OF PROPORTIONALITY IN WAKE REGION (0.018 IS A TYPICAL VALUE).

SCT IS THE TURBULENT SCHMIDT NUMBER.

PRT IS THE TURBULENT PRANDTL NUMBER.

RETR IS THE TRANSITION REYNOLDS NUMBER BASED ON MOMENTUM THICKNESS. IF RETR IS EXCEEDED, TURBULENCE TERMS WILL BE INCLUDED IN THE GOVERNING EQUATIONS.

GROUP 9 FIRST GUESS OR RESTART INFORMATION (CALLED FROM FIRSTG) **** SKIP THIS GROUP FOR KR(2)=2. CONSIDER ONLY CARD 6 FOR KR(2)=0 ****

CARD 1, FORMAT(3E10.4,5X,I5) **** USED ONLY FOR KR(2)=1 OR 3 ****

FIELD 1 (COLUMN 1-10) ALPH

FIRST GUESS OR RESTART VALUE FOR BOUNDARY LAYER NORMALIZING PARAMETER (USE A 1.0 IF A BETTER GUESS IS NOT KNOWN).

FIELD 2 (COLUMNS 11-20) F(1,1)

FIRST GUESS OR RESTART VALUE FOR STREAM FUNCTION AT THE WALL.

FIELD 3 (COLUMNS 21-30) F(3,1)

FIRST GUESS OR RESTART VALUE FOR NORMALIZED VELOCITY GRADIENT AT THE WALL.

FIELD 4 (COLUMN 36-40, RIGHT JUSTIFIED) IST

STATION NUMBER FOR RESTART. MEANINGFUL ONLY FOR KR(2)=3.

CARD SET 2, FORMAT(8E10.4) **** USED ONLY FOR KR(2)=1 OR 3 ****

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD, F(2,I), I=1,NETA.

FIRST GUESSES OR RESTART VALUES FOR VELOCITY RATIO F(2,I) ACROSS THE BOUNDARY LAYER.

CARD SET 3, FORMAT(8E10.4) **** USED ONLY FOR KR(2)=1 OR 3 ****

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD, G(2,1), G(1,I), I=1,NETA

FIRST GUESSES OR RESTART VALUES FOR ENTHALPY GRADIENT AT THE WALL G(2,1) AND ENTHALPY G(1,I) ACROSS THE BOUNDARY LAYER, BTU/LB.

CARD SET 4, FORMAT(8E10.4; **** USED ONLY FOR KR(2)=1 OR 3 AND NSP GREATER THAN 1 ****

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD, (SP(2,1,K), SP(1,I,K), I=1,NETA) K=1, NSP-1

FIRST GUESSES OR RESTART VALUES FOR ELEMENTAL MASS FRACTION GRADIENT AT THE WALL SP(2,1,K) AND ELEMENTAL MASS FRACTION VALUES SP(1,I,K) ACROSS THE BOUNDARY LAYER. READ IN WALL GRADIENT AND VALUES AT NODES FOR EACH SPECIES BEFORE GOING ON TO NEXT SPECIES. START EACH SPECIES ON A NEW CARD.

CARD SET 5, FORMAT(40I2) **** USED ONLY FOR KR(2)=1 OR 3 AND NSP GREATER THAN 1 ****

FIELD 1 (COLUMNS 1-2, RIGHT JUSTIFIED), FIELD 2 (COLUMNS 3-4, RIGHT JUSTIFIED), ETC., (LEF(K), K=1,NSP) (SEE CARD 1 OF GROUP 2)

ENTRIES IN THESE FIELDS MUST INDIVIDUALLY CORRESPOND TO THE ELEMENTS AS THEY ARE SELECTED FROM THE THERMODYNAMIC DATA (SEE DISCUSSION UNDER GROUP 13) ACCORDING TO WHETHER, FOR THE FIRST STATION, THE ELEMENT IS

0 NOT PRESENT

1 PRESENT DUE TO LOCAL INJECTION

2 PRESENT DUE TO UPSTREAM INJECTION (NOT POSSIBLE AT FIRST STATION)

3 PRESENT FROM THE EDGE GAS

CARD 6, FORMAT(E10.4) ***** USED ONLY FOR KR(2)=0 *****

FIELD 1 (COLUMNS 1-10), GW

FIRST GUESS FOR ENTHALPY OF THE GAS AT THE WALL, BTU/LB

GROUP 10 THIS CARD GROUP IS NOT USED IN THE PRESENT VERSION OF THE PROGRAM.

GROUP 11 ELEMENTAL DATA (CALLED FROM INPUT)
**** SKIP THIS GROUP FOR KR(12)=1 OR 6 OR FOR KR(7)=1 OR 3 ****

CARD 1, FORMAT(I3,F7.0,7F10.4) **** USED ONLY FOR KR(12)=0,2,5, OR 7

FIELD 1 (COLUMNS 1-3, RIGHT-JUSTIFIED), IS

NUMBER OF ELEMENTS IN THE SYSTEM INCLUDING ELECTRONS IF CONSIDERED (THIS ENTRY WILL BE THE SAME AS CARD 1 OF GROUP 2 (EXCEPT FOR THE DIFFERENT FORMAT) FOR SYSTEMS NOT CONTAINING ELECTRONS BUT WILL BE ONE GREATER FOR SYSTEMS CONTAINING ELECTRONS)

FIELDS 2 AND 3 (COLUMNS 4-10,11-20) FFAR, FITMOL

CONSTANTS IN THE CURVEFIT OF FF(J) IN TERMS OF MOLECULAR WEIGHT..

FF(J)=(WTM(J)/FITMOL)**FFAR

FFAR AND FITMOL ARE PRESUMED TO BE 0.431 AND 23.4 IF NO ENTRY IS MADE.

FIELDS 4, 5, AND 6 (COLUMNS 21-30, 31-40, 41-50) BASMOL, SIGMA, EPOVRK

THESE VARIABLES DEFINE THE REFERENCE SPECIES PROPERTIES FOR FF(J) (REF. 5). BASMOL IS THE MOLECULAR WEIGHT OF THE REFERENCE SPECIES. SIGMA AND EPOVRK ARE THE SPECIES SIGMA AND EPSILON/K AS DEFINED BY REFERENCE 6. FOR THE CONVENIENCE OF THE USER, A TABLE OF SIGMA AND EPOVRK REPRODUCED FROM REFERENCE 6 IS INCLUDED AS APPENDIX II TO THIS MANUAL. STANDARD VALUES DESCRIBED IN REFERENCE 5 ARE USED IF NO ENTRIES ARE MADE.

FIELD 7 (COLUMNS 71-80) TF(N+1) **** USED ONLY FOR KR(9) = 2 WITH KR(11) = 0 ****

ABLATION TEMPERATURE, ABOVE WHICH EQUILIBRIUM CHAR REMOVAL RATE WILL BE DETERMINED. BELOW THIS TEMPERATURE, SURFACE EQUILIBRIUM IS SUPPRESSED. AUTOMATICALLY SET TO 50,000 K IF NO ENTRY. AN ABLATION TEMPERATURE MUST BE ENTERED HERE IF SURFACE CHEMISTRY IS TO BE CONSIDERED.

CARDS 2,3,...,IS (ONE FOR EACH ELEMENT, SEE CARD 1, FIELD 1 OF THIS GROUP), FORMAT(I3,3A4,E9.3,7E8.3) **** USED ONLY FOR KR(12)=0,2,5, OR 7 ***

FIELD 1 (COLUMNS 1-3, RIGHT-JUSTIFIED), KAT(K)

ATOMIC NUMBER OF ELEMENT (99 FOR ELECTRON), CARDS MUST BE ORDERED WITH THIS NUMBER ASCENDING WITH ELECTRON LAST (WHEN CONSIDERED).

FIELD 2, (COLUMNS 4-15) ATA(K), ATB(K), ATC(K)

NAME OF ELEMENT (USED FOR OUTPUT ONLY). FOR BEST LOOKING OUTPUT, ELEMENTS WITH 3 OR 4 LETTERS (EG., IRON) SHOULD START IN COLUMN 6, ELEMENTS WITH 5, 6, OR 7 LETTERS (EG., CARBON) SHOULD START IN COLUMN 5, AND ELEMENTS WITH 8 OR MORE LETTERS (EG., NITROGEN) SHOULD START IN COL. 4.

FIELD 3 (COLUMNS 16-24), WAT(K)

ATOMIC WEIGHT OF ELEMENT

FIELD 4 (COLUMNS 25-32) TK(K,1)

AMOUNT OF ELEMENT IN BOUNDARY-LAYER EDGE GAS. SEE BELOW FOR UNITS.

FIELDS 5 TO 10 (COLUMNS 33-40, 41-48, 49-56, 57-64, 65-72, 73-80) TK(K,J) J=2,7

AMOUNT OF ELEMENT IN PYROLYSIS GAS AND CHAR FOR EACH OF THE THREE ALLOWABLE MATERIALS. FIELDS 5 AND 6 ARE FOR MATERIAL 1, FIELDS 7 AND 8 FOR MATERIAL 2, ETC. NEGATIVE VALUES ARE USED TO DESIGNATE RELATIVE MASSES OF ELEMENTS, WHEREAS POSITIVE VALUES ARE USED TO DESIGNATE RELATIVE NUMBERS OF ATOMS. AS AN EXAMPLE OF THE LATTER, THE ENTRIES FOR A SILICA CHAR COULD BE 1. FOR THE ELEMENT SILICON AND 2. FOR OXYGEN.

GROUP 12 DIFFUSION FACTOR DATA (CALLED FROM INPUT)

**** SKIP THIS GROUP FOR KR(7)=1 OR 3 OR FOR KR(12)=1 OR 6 OR IF IT IS DESIRED TO USE THE MOLECULAR WEIGHT APPROXIMATION FOR DIFFUSION FACTORS (SEE FIELDS 2 AND 3 OF CARD 1 OF GROUP 11). ALWAYS SKIP FOR KR(7)=1 OR 3. ****

CARD 1, FORMAT(I3) ***** USED ONLY FOR KR(12)=0, 2, 5 OR 7 AND THEN ONLY IF IT IS DESIRED TO READ IN DIFFUSION FACTOR DATA FOR ONE OR MORE SPECIES *****

FIELD 1 (COLUMNS 1-3, RIGHT-JUSTIFIED) NFF

NUMBER OF MOLECULES FOR WHICH DIFFUSION FACTOR DATA ARE TO BE READ (SEE FIELDS 2 AND 3 OF CARD 1 OF GROUP 11).

CARDS 2, 3,...., AS REQUIRED (DIFFUSION FACTOR DATA REQUESTED BY CARD 1 OF THIS GROUP ARE ENTERED HERE 4 TO A CARD) FORMAT(4(2A4,E12.4)) ***** USED ONLY FOR KR(12)=0, 2, 5 OR 7 AND THEN ONLY IF THE CONDITIONS OF CARD 1 OF THIS GROUP ARE MET *****.

FIELDS 1, 3, 5, AND 7 (COLUMNS 1-8, 21-28, 41-48, AND 61-68, RESPECTIVELY) NFIA(J) AND NFIB(J) IN EACH FIELD

NAME OF MOLECULE AS IT APPEARS IN COLUMNS 73-80 ON FIRST CARD OF 3-CARD THERMODYNAMIC DATA SET FOR THE MOLECULE (SEE GROUP 13, CARDS 1, 4, 7, .)

FIELDS 2, 4, 6, AND 8 (COLUMNS 9-20, 29-40, 49-60, AND 69-80 RESPECTIVELY)
FFIN(J) IN EACH FIELD

A SET OF FF(J) ARE INCLUDED IN THE PROGRAM. IF ANY OF THESE ARE TO BE CHANGED, THE NEW VALUES FOR EACH OF THE SPECIES NAMED IN FIELDS 1,3,5 ETC. ARE ENTERED HERE UNDER THE VARIABLE NAME FFIN(J). THEY ARE THEN SORTED BY SPECIES NAME AND ENTERED INTO THE PROPER SLOTS IN THE FF(J) ARRAY. THESE DIFFUSION FACTORS ARE REFERENCED TO OXYGEN (O2) OR OTHER REFERENCE SPECIES INDICATED IN GROUP 11. TO OBTAIN ACCURATE VISCOSITY CALCULATIONS USE

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FF(J)=(SIGMA(J)*WTM(J)**.25*EPOVRK(J)**.0795)/(SIGMA(REF)*WTM(REF)
          **.25*EPOVRK(REF)**.0795)
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GROUP 13 THERMOCHEMICAL DATA (CALLED FROM INPUT)
***** SKIP THIS GROUP FOR KR(12)=1 OR 6 OR KR(7)=1 OR 3 ****

THERE ARE THREE CARDS FOR EACH MOLECULAR, ATOMIC, CONDENSED, OR IONIC SPECIES. A TOTAL OF 70 SPECIES OF ALL TYPES ARE ALLOWED. THE NUMBER OF ALLOWABLE CONDENSED-PHASE MATERIALS WHICH CAN BE SIMULTANEOUSLY PRESENT IN ANY SOLUTION IS 4. ANY NUMBER OF CONDENSED PHASE SPECIES CAN BE INCLUDED IN THE THERMOCHEMICAL DATA DECK. (NOTE... CONDENSED SPECIES ARE REQUIRED IN SURFACE EQUILIBRIUM CALCULATIONS FOR CONSIDERATION AS CANDIDATE SURFACE MATERIALS BUT ARE NOT PRESENTLY CONSIDERED AS CANDIDATE SPECIES WITHIN THE BOUNDARY LAYER). A BLANK CARD AFTER THE LAST SET CONCLUDES THE THERMODYNAMIC DATA. THE ARRANGEMENT OF THESE CARD SETS IS OF CONSEQUENCE IN SO FAR AS IT DETERMINES THE BASE SPECIES UPON WHICH MASS BALANCES ARE PERFORMED, THE FIRST INDEPENDENT SET OF BASE SPECIES BEING SELECTED. SINGULAR MATRICES CAN RESULT FROM CERTAIN SETS OF THEORETICALLY ACCEPTABLE BASE SPECIES DUE TO ROUND-OFF ERRORS. FURTHERMORE, MASS BALANCES, ETC. FOR THE (NSP)TH BASE SPECIES (SEE CARD 1 OF GROUP 2) IS OBTAINED BY DIFFERENCE. THEREFORE, THE ELEMENT REPRESENTED BY THIS BASE SPECIES SHOULD BE PRESENT IN APPRECIABLE QUANTITIES THROUGHOUT THE BOUNDARY LAYER. FOR EXAMPLE, FOR ABLATION IN AIR, MOLECULAR NITROGEN IS A GOOD CHOICE FOR THE (NSP)TH BASE SPECIES. FINALLY, THE ORDER OF THE BASE SPECIES DETERMINES THE REACTANTS FOR KINETICS PROBLEMS (SEE GROUP 14, CARD 3) EXCEPT FOR THESE CONSIDERATIONS, ATOMIC, MOLECULAR, AND CONDENSED SPECIES CAN BE ARRANGED IN ANY ORDER. WHEN IONIZED FLOWS ARE CONSIDERED, THE ATOMIC, MOLECULAR AND CONDENSED SPECIES DATA MUST APPEAR FIRST AND BE FOLLOWED BY, FIRST, ELECTRON SPECIES DATA, AND

THEN THE IONIC SPECIES DATA (WHICH CAN BE IN ANY ORDER). THE DATA FORMAT ACCEPTED BY THE PROGRAM (DESCRIBED BELOW) IS AS GENERATED BY THE AEROTHERM TCDATA PROGRAM AND IS THE SAME AS THAT USED IN NAVWEPS REPORT 7043. THERMOCHEMICAL DATA DECKS HAVE BEEN GENERATED FOR ABOUT 600 SPECIES, BASED MOSTLY ON CURVE FITS OF JANAF DATA.

CARDS 1, 4, 7, ..., ONE FOR EACH MOLECULE FORMAT(7(F3.0,I3),30X,2A4)
***** USED ONLY FOR KR(12)=0, 2, 5 OR 7 *****

FIELDS 1, 3, 5, ..., ONE FOR EACH ELEMENT IN MOLECULE (COLUMNS 1-3, 7-9, 13-15, ...), ALPT(N) IN EACH FIELD

NUMBER OF ATOMS (OF ATOMIC NUMBER GIVEN IN SUBSEQUENT FIELD) IN A MOLECULE OF THIS SPECIES. IF FIELD ONE IS ZERO THIS CARD IS PRESUMED TO BE THE END OF THE THERMODYNAMIC DATA.

FIELDS 2, 4, 6, ..., ONE FOR EACH ELEMENT IN MOLECULE (COLUMNS 4-6, 10-12, 16-18, ...), JAT(N) IN EACH FIELD

ATOMIC NUMBERS OF ELEMENTS IN MOLECULES (LISTED IN ASCENDING SEQUENCE).

LAST FIELD (COLUMNS 73-80)

MOLECULAR DESIGNATION (E.G., SIO2) FOR OUTPUT AND AS IDENTIFIER FOR DIFFUSION FACTOR DATA.

CARDS 2, 5, 8, ..., ONE FOR EACH MOLECULE FORMAT(6E9.6,6X,F6.0,I1)
***** USED ONLY FOR KR(12)=0, 2, 5 OR 7 *****

FIELD 1 (COLUMNS 1-9), RA(J)

HEAT OF FORMATION OF MOLECULE AT 298 DEG K FROM JANAF BASE STATE (ELEMENTS IN MOST NATURAL FORM AT 298 DEG. K), CAL/MOLE.

FIELDS 2-6 (COLUMNS 10-18, 19-27, 28-36, 37-45, AND 46-54), CH(J,1), RC(J,1),RD(J,1),RE(J,1), RF(J,1)

CONSTANTS APPROPRIATE TO LOWER TEMPERATURE RANGE OF THERMODYNAMIC DATA. TAKING F2, F3, ..., AS FIELDS 2, 3, ETC., THE CURVE FITS ARE AS FOLLOWS WITH T IN DEG K, H IN CAL/MOLE, AND S IN CAL/MOLE DEG K.

HEAT CAPACITY, CP=F3+F4*T+F5/T**2

ENTHALPY, H-H298=F2+F3*(T-3000)+0.5*F4*(T**2-3000**2)
-F5*(1/T-1/3000)

ENTROPY, S=F6+F3*LN(T/3000)+F4*(T-3000)-0.5*F5*(1/T**2-1/3000**2)

FIELD 7 (COLUMNS 61-66), TU(J,1)

UPPER LIMIT OF LOWER TEMPERATURE RANGE IN DEG K. (FOR CONDENSED-PHASE MATERIALS WHICH MELT, IT IS APPROPRIATE TO USE MELT TEMPERATURES).

FIELD 8 (COLUMN 67), KPHA(1)

1 SIGNIFIES GASEOUS SPECIES

2 SIGNIFIES SOLID SPECIES

3 SIGNIFIES LIQUID SPECIES

CARDS 3, 6, 9, ..., ONE FOR EACH MOLECULE FORMAT(6E9.6,6X,F6.0,I1)
***** USED ONLY FOR KR(12)=0, 2, 5 OR 7 *****

FIELDS 1-8 (COLUMNS 1-67)

SAME AS CARDS 2, 5, 8, ..., EXCEPT USE CONSTANTS FOR UPPER TEMPERATURE RANGE AND FIELD 7 IS THE FAIL TEMPERATURE OF THIS SPECIES AS A SURFACE.

LAST CARD .... AS MENTIONED PREVIOUSLY, A BLANK CARD IS USED TO SIGNIFY THE END OF THERMOCHEMICAL DATA

GROUP 14 SURFACE KINETIC DATA (CALLED FROM INPUT)
**** SKIP THIS GROUP FOR KR(12)=0,1, OR 2 OR KR(7)= 1 OR 3 ****

REACTIONS OF THE SURFACE MATERIALS WITH ADJACENT BOUNDARY LAYER GASES CAN BE KINETICALLY CONTROLLED ACCORDING TO AN ARRHENIUS TYPE RELATION. FOR EXAMPLE, IN THE REACTION

C* + 1/2 O2 → CO

THE MASS FLUX RELATION IS

$$\frac{\dot{m}_c}{\mathcal{M}_c} = \mathrm{FKF}*\exp\left(\mathrm{EAK}/(1.9869*\mathrm{T})\right)*\left(P_{O_2}^{1/2} - \frac{P_{CO}}{K_p}\right)^{\mathrm{EXK}}$$

WHERE

$\dot{m}_c$	=	CARBON MASS FLUX
$\mathcal{M}_c$	=	CARBON MOLECULAR WEIGHT
FKF	=	PRE-EXPONENTIAL FACTOR
EAK	=	ACTIVATION ENERGY
T	=	TEMPERATURE
P	=	PARTIAL PRESSURE OF THE SUBSCRIPTED SPECIES
K	=	EQUILIBRIUM CONSTANT
EXK	=	REACTION ORDER

THESE CONSTANTS AND FACTORS ARE INPUT ON THE CARDS DESCRIBED BELOW. FURTHER DISCUSSION OF KINETIC MODELS FOR ABLATION CAN BE FOUND IN REFERENCE 7, FOR EXAMPLE-

CARD 1, FORMAT(I3)

FIELD 1 (COLUMNS 1-3,RIGHT JUSTIFIED), MT

NUMBER OF KINETICALLY CONTROLLED REACTIONS TO BE CONSIDERED. IF TWO PROBLEMS ARE STACKED TOGETHER SEPARATED BY A COMMA (SEE CARD 1 OF LAST GROUP) AND IF THE FIRST IS A KINETICS PROBLEM AND THE SECOND IS TO BE EQUILIBRIUM, THEN FOR THE SECOND, KINETICS MUST BE TURNED OFF USING KR(12)=5,6 OR 7 AND MT=0.

CARDS 2,5,8...., ONE FOR EACH KINETICALLY CONTROLLED REACTION, FORMAT(8E10.4)

FIELD 1 (COLUMNS 1-10), FKF(N)

PRE-EXPONENTIAL FACTOR FOR SURFACE MASS BALANCES IN LB-MOLES OF REACTANT PER FT**2 PER SECOND.

FIELD 2 (COLUMNS 11-20), EAK(N)

ACTIVATION ENERGY FOR THE FORWARD REACTION IN CALORIES PER GRAM-MOLE

FIELD 3 (COLUMNS 21-30), EXK(N)

REACTION EXPONENT. THE DRIVING POTENTIAL AS OBTAINED FROM THE REACTION STOICHIOMETRY IS RAISED TO THIS POWER IN EVALUATING THE REACTION RATE. EXK = 1.0 IS RECOMMENDED.

CARDS 3,6,9...., ONE FOR EACH KINETICALLY CONTROLLED REACTION, FORMAT(8E10.4)

FIELDS 1,2,3,...., ONE FOR EACH BASE SPECIES (COLUMNS 1-10,11-20,....), RMU(K,N)

STOICHIOMETRIC COEFFICIENTS ON REACTANTS. IN THE PRESENT FORMULATION ONLY BASE SPECIES MAY BE USED AS REACTANTS. THUS SOME CARE MUST BE USED IN ESTABLISHING THE ORDER OF GROUP 13.

CARDS 4,7,10...., ONE FOR EACH KINETICALLY CONTROLLED REACTION, FORMAT(8E10.4)

FIELDS 1,2,3,...., ONE FOR EACH BASE SPECIES (COLUMNS 1-10,11-20,....), PMU(K,N)

STOICHIOMETRIC COEFFICIENTS ON THE PRODUCTS, OR ON THEIR EQUILIBRIUM BASE SPECIES EQUIVALENTS IF THEY ARE NOT BASE SPECIES. FOR EXAMPLE IF THE BASE SPECIES ARE CO, H2O, H2, AND C* FOR A SYSTEM WHERE C* IS THE ONLY ISOLATED (NONEQUILIBRIUM) SPECIES, A REACTION WRITTEN AS

H2 + 2C* = C2H2

COULD EQUIVALENTLY BE WRITTEN

H2 + 2C* = 2CO + 3H2 - 2H2O

AND THIS IS THE MANNER IN WHICH THE PRODUCT COEFFICIENTS WOULD BE INPUT. THIS EQUIVALENT REPRESENTATION CAN NOT BE USED FOR REACTANTS.

GROUP 15 STREAMWISE DISTRIBUTIONS FOR EDGE CONDITIONS (CALLED FROM REFCON)

CARD SET 1, FORMAT(8E10.4) ***** USED ONLY FOR KR(5)=5 *****

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD,
DSIP(L), L=1,NS (SEE CARD 3 OF GROUP 3)

DECREASE IN EDGE ENTROPY FROM PREVIOUS STATION TO CURRENT STATION, CAL/GM DEG K (THE STAGNATION POINT ENTROPY IS COMPUTED BY THE PROGRAM. DSIP IS USED TO DECREMENT THE ENTROPY AT DOWNSTREAM STATIONS TO TAKE INTO ACCOUNT SHOCK CURVATURE. DSIP(1) SHOULD BE SET EQUAL TO ZERO.)

CARD 2, FORMAT(I2) ***** USED ONLY IF CARD SET 1 IS USED *****

FIELD 1 (COLUMNS 1-2, RIGHT-JUSTIFIED), IDSIP

IYEM WHEN DSIP IS TO BE UPDATED WHERE ITEM IS INDEX ON TIME (OR SUBCASE) USE BLANK CARD IF DSIP IS TO REMAIN UNCHANGED FOR ALL REMAINING TIMES OR IF NO MORE TIMES ARE TO BE CONSIDERED.

CARD SET 3, FORMAT(8E10.4)

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD,
PRE(L), L=1,NS (SEE CARD 3 OF GROUP 3)

RATIO OF LOCAL STATIC TO STAGNATION PRESSURE. IN ADDITION TO DEFINING THE LOCAL PRESSURE, THIS DATA IS USED TO FORM THE LOCAL VELOCITY GRADIENT AT THE STAGNATION POINT AND OTHER BODY STATIONS. DUE TO THE SENSITIVITY OF THE PROGRAM TO THE VELOCITY GRADIENT IN THE STAGNATION REGION, TWO OPTIONS HAVE BEEN INCORPORATED TO ALLOW A SMOOTHER VELOCITY GRADIENT DISTRIBUTION THAN IS TYPICALLY OBTAINED BY READING NUMBERS FROM A SET OF CURVES, FOR EXAMPLE. THE VARIOUS OPTIONS ARE CONTROLLED BY THE ENTRIES IN THIS PRESSURE TABLE AND THE EFFECTIVE NOSE RADIUS ENTRY (GROUP 5, CARD 1, FIELD 2).

1) PRE(1) IS READ IN BUT RNOSE IS NOT

THE INPUT PRESSURES ARE CURVEFITTED AND PRESSURE AND VELOCITY GRADIENTS ARE EVALUATED DIRECTLY FROM THE RESULTING CURVE.

2) PRE(1) AND RNOSE BOTH READ IN.

STAGNATION POINT VELOCITY GRADIENT EVALUATED FROM

```
DUES = 1./RNOSE*SQRT(2.*PE/RHOE*32.174*2116.)
```

3) PRE(1) NOT READ IN, AND PRE (   ) NOT READ IN FOR AN ARBITRARY NUMBER OF STATIONS,

IN THIS INSTANCE THE VELOCITY GRADIENT IS ASSUMED TO BE LINEAR AND A NEWTONIAN PRESSURE DISTRIBUTION FOR SMALL S/R IS ASSUMED AT THOSE STATIONS FOR WHICH NO PRESSURE IS INPUT. FIRST, AN EFFECTIVE NOSE RADIUS, RNOSE, IS COMPUTED FROM THE FIRST NONZERO PRESSURE ENTRY FROM THE RELATION

```
RNOSE = S(L)/SQRT(1-PRE(L))
```

THE STAGNATION POINT VELOCITY GRADIENT IS THEN FOUND AS IN OPTION (2) ABOVE. PRESSURE FOR STATION LL LESS THAN L IS FOUND FROM

```
PRE(LL) = 1. - (S(LL)/RNOSE)**2
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CARD 4, FORMAT(I2) ***** USED ONLY IF CARD SET 3 IS USED *****

FIELD 1 (COLUMNS 1-2, RIGHT-JUSTIFIED), IPRE

ITEM WHEN PRE IS TO BE UPDATED WHERE ITEM IS INDEX ON TIME (OR SUBCASE) USE BLANK CARD IF PRE IS TO REMAIN UNCHANGED FOR ALL REMAINING TIMES OR IF NO MORE TIMES ARE TO BE CONSIDERED.

CARD SET 5, FORMAT(8E10.4)

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD, RADR(L), L=1,NS (SEE CARD 3 OF GROUP 3)

RATIO OF LOCAL TO STAGNATION POINT INCIDENT RADIATION. THIS INFORMATION IS USED ONLY FOR KR(9) OR KR9 OF 4. INPUT BLANKS INTO THIS FIELD FOR OTHER TYPES OF PROBLEMS.

CARD 6, FORMAT(I2)

FIELD 1 (COLUMNS 1-2, RIGHT-JUSTIFIED), IRAD

ITEM WHEN RADR IS TO BE UPDATED WHERE ITEM IS INDEX ON TIME (OR SUBCASE) USE BLANK CARD IF RADR IS TO REMAIN UNCHANGED FOR ALL REMAINING TIMES OR IF NO MORE TIMES ARE TO BE CONSIDERED.

GROUP 16 STREAMWISE DISTRIBUTIONS FOR INPUT WALL CONDITIONS
(CALLED FROM REFCON)

CARD SET 1, FORMAT(8E10.4) *** USED ONLY FOR KR(11)=1 AND KR(9)=0,1, OR 2 **

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD,
HW(L,1), L=1,NS (SEE CARD 3 OF GROUP 3)

ENTHALPY OF THE GAS AT THE WALL, BTU/LB

CARD 2, FORMAT(I2) ***** USED ONLY IF CARD SET 1 IS USED *****

FIELD 1 (COLUMNS 1-2, RIGHT-JUSTIFIED), IHW

ITEM WHEN HW IS TO BE UPDATED WHERE ITEM IS INDEX ON TIME (OR SUBCASE).
USE BLANK CARD IF HW IS TO REMAIN UNCHANGED FOR ALL REMAINING TIMES OR
IF NO MORE TIMES ARE TO BE CONSIDERED.

CARD SET 3, FORMAT(8E10.4) ***** USED ONLY IF KR(11)=0 AND KR(9)=0,1, OR 2,
IF KR(9)=3 OR IF ANY OF THE KR9=2 OR 3 ****

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD,
TW(L,1), L=1,NS (SEE CARD 3 OF GROUP 3)

WALL TEMPERATURE, DEG R

CARD 4, FORMAT(I2) ***** USED ONLY IF CARD SET 3 IS USED *****

FIELD 1 (COLUMNS 1-2, RIGHT-JUSTIFIED), ITW

ITEM WHEN TW IS TO BE UPDATED WHERE ITEM IS INDEX ON TIME (OR SUBCASE).
USE BLANK CARD IF TW IS TO REMAIN UNCHANGED FOR ALL REMAINING TIMES OR
IF NO MORE TIMES ARE TO BE CONSIDERED.

CARD SET 5, FORMAT(8E10.4) ***** USED ONLY FOR KR(9)=0 AND KR(11)=0 OR 1 ***

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD,
FW(L,1), L=1,NS (SEE CARD 3 OF GROUP 3)

WALL STREAM-FUNCTION (NEGATIVE FOR MASS ADDITION)

CARD 6, FORMAT(I2) ***** USED ONLY IF CARD SET 5 IS USED *****

FIELD 1 (COLUMNS, 1-2, RIGHT-JUSTIFIED), IFW

ITEM WHEN FW IS TO BE UPDATED WHERE ITEM IS INDEX ON TIME (OR SUBCASE).
USE BLANK CARD IF FW IS TO REMAIN UNCHANGED FOR ALL REMAINING TIMES OR
IF NO MORE TIMES ARE TO BE CONSIDERED.

CARD SET 7, FORMAT(8E10.4) ***** USED ONLY FOR KR(9)=1 AND KR(11)=0 OR 1 ***

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD,
RHOVW(L,1), L=1,NS (SEE CARD 3 OF GROUP 3)

TOTAL MASS FLUX AT THE WALL (LB/SEC FT2 OR DIMENSIONLESS FOR KR(8)=0 OR 1, RESPECTIVELY, POSITIVE FOR MASS INJECTION)

CARD 8, FORMAT(I2) ***** USED ONLY IF CARD SET 7 IS USED *****

FIELD 1 (COLUMNS 1-2, RIGHT-JUSTIFIED), IRHOVW

ITEM WHEN RHOVW IS TO BE UPDATED WHERE ITEM IS INDEX ON TIME (OR SUBCASE). USE BLANK CARD IF RHOVW IS TO REMAIN UNCHANGED FOR ALL REMAINING TIMES OR IF NO MORE TIMES ARE TO BE CONSIDERED.

CARD SET 9, FORMAT(8E10.4) **** USED ONLY FOR KR(7)=0 OR 2, KR(9)=0 OR 1, AND KR(11)=0 OR 1.

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD,
DO K=1,NSPM1 SPW(K,L,1), L=1,NS NSPM1=NSP-1 (SEE CARD 1 OF GROUP 2 AND CARD 3 OF GROUP 3)

WALL ELEMENTAL MASS FRACTIONS IN THE SAME ORDER THAT THEY ARE SELECTED FROM THE THERMODYNAMIC DATA (SEE DISCUSSION UNDER GROUP 13)

CARD 10, FORMAT(I2) ***** USED ONLY IF CARD SET 9 IS USED *****

FIELD 1 (COLUMNS 1-2, RIGHT-JUSTIFIED), ISPW

ITEM WHEN THE SPW ARE TO BE UPDATED WHERE ITEM IS INDEX ON TIME (OR SUBCASE). USE BLANK CARD IF THE SPW ARE TO REMAIN UNCHANGED FOR ALL REMAINING TIMES OR IF NO MORE TIMES ARE TO BE CONSIDERED.

CARD SET 11, FORMAT(8E10.4) **** USED ONLY FOR KR(7)=0 OR 2 WITH KR(9)=2 AND KR(11)=0,1, OR 2, OR WITH ANY OF THE KR9=2

FIELD 1 (COLUMNS 1-10), FIELD 2 (COLUMNS 11-20), ETC., 8 TO A CARD,
DO N=1,3 FLUXJ(N,L,1), L=1,NS (SEE CARD 3 OF GROUP 3)

WALL MASS FLUXES OF BOUNDARY-LAYER EDGE GAS, PYROLYSIS GAS, AND CHAR, RESPECTIVELY (SEE GROUP 11, CARDS 2,3, ..., FIELD 4), LB/SEC FT2 OR DIMENSIONLESS FOR KR(8) = 0 OR 1, RESPECTIVELY. POSITIVE FOR MASS INJECTION WHEN KR(8) = 0 AND NEGATIVE FOR MASS INJECTION WHEN KR(8)=1. READ IN ALL EDGE GAS VALUES, THEN START PYROLYSIS GAS VALUES ON A NEW CARD AND READ ALL PYROLYSIS GAS VALUES, ETC.

CARD 12 FORMAT(I2) ***** USED ONLY IF CARD SET 11 IS USED *****

FIELD 1 (COLUMNS 1-2, RIGHT-JUSTIFIED), IFLUXJ

ITEM WHEN THE FLUXJ ARE TO BE UPDATED WHERE ITEM IS INDEX ON TIME (OR SUBCASE). USE BLANK CARD IF THE FLUXJ ARE TO REMAIN UNCHANGED FOR ALL REMAINING TIMES OR IF NO MORE TIMES ARE TO BE CONSIDERED.

GROUPS 17,18,19, ..., (13+NITEM) SEE CARD 1 OF GROUP 3 (CALLED FROM REFCON)

UPDATING INFORMATION FOR STREAMWISE DISTRIBUTIONS OF EDGE AND WALL CONDITIONS FOR TIMES 2,3,4, ..., NITEM. NO ADDITIONAL INFORMATION AFTER GROUP 16 IS REQUIRED FOR NITEM = 1 OR IF CARDS 2,4,6,... OF GROUPS 15 AND 16 ARE ALL BLANK. DATA ARE SUPPLIED FOR EACH SET AND ONLY EACH SET OF STREAMWISE INFORMATION FOR WHICH THE CURRENT TIME HAS BEEN DESIGNATED IN A PREVIOUS GROUP (E.G. CONSIDER TW AT TIME 4 (GROUP 19). TW DATA (I.E., CARD SET 3 AND CARD 4 OF GROUP 16 WOULD BE REQUIRED IF A 4 HAS APPEARED IN CARD 4 OF GROUP 18,17 OR 16) ALL DATA REQUIRED AT TIME 2 (IF ANY) ARE SUPPLIED. FIRST (GROUP 17), THEN FOR TIME 3 (GROUP 18), TIME 4 (GROUP 19), ETC. FOR EACH TIME, THESE DATA ARE SUPPLIED IN THE SAME ORDER AS LISTED UNDER GROUPS 15 AND 16. FORMATS ARE THE SAME AS IN GROUPS 15 AND 16. IN PARTICULAR, IT SHOULD BE NOTED THAT EACH ODD-NUMBERED CARD MUST BE FOLLOWED BY THE APPROPRIATE EVEN-NUMBERED CARD SIGNIFYING FOR WHAT TIME (IF ANY) DATA OF THIS SAME TYPE IS TO BE UPDATED AGAIN.

LAST GROUP (CALLED FROM BLIMP)

CARD 1 FORMAT(A1)

FIELD 1 (COLUMN 1), JAST

THE PURPOSE OF THIS ENTRY IS TO PERMIT A TEST ON WHETHER OR NOT A NEW CASE IS TO FOLLOW. IN THE EVENT A CASE DOES NOT CONVERGE IN THE ALLOTTED NUMBER OF ITERATIONS, ANY REMAINING CARDS FOR THAT CASE ARE READ AND THEN IGNORED UNTIL A COMMA (,) OR A PERIOD (.) IS ENCOUNTERED IN COLUMN 1. A COMMA SIGNIFIES ANOTHER CASE, WHILE A PERIOD SIGNIFIES THAT THERE ARE NO CASES TO FOLLOW.

SECTION IV

OUTPUT

The BLIMP program provides a complete set of output data for each boundary layer solution including such global quantities as the various boundary layer thicknesses, wall heat and mass fluxes, and transfer coefficients plus profiles of state and transport properties as well as profiles of the primary variables (e.g., f, f' f"). This output is provided automatically for each converged boundary layer solution and can also be obtained after each iteration if requested by KR(4) = 1. In either event, a one-line-per-iteration output of the boundary layer iteration is always provided. In addition, most of the input data are output as are the results of the boundary layer edge expansion. The specific output of these various types are presented in Subsections 1-7 below. Along with the title appearing in the output are presented the Fortran variable, dimensions, and a brief definition. Sample output for several cases are presented in Section V.

Additional debug output can be obtained by use of nonzero values of KR(15) through KR(20) or when chemistry nonconvergences (or impending nonconvergences) occur. This is described in Section VI.

1. SUMMARY OF STANDARD OUTPUT

STANDARD OUTPUT OF BOUNDARY LAYER INPUT DATA

STANDARD OUTPUT OF PROPERTY INPUT DATA

STANDARD CHEMISTRY OUTPUT FOR BOUNDARY LAYER EDGE EXPANSION

SUMMARY TABLE OF EDGE CONDITIONS

ONE-LINE-PER-ITERATION OUTPUT OF BOUNDARY LAYER ITERATION

STANDARD OUTPUT FOR BOUNDARY LAYER SOLUTION

2. STANDARD OUTPUT OF BOUNDARY LAYER INPUT DATA (CALLED FROM RECASE)

TITLE APPEARING IN OUTPUT	FORTRAN VARIABLE	UNITS	DEFINITION
IDENTIFICATION	IDENT		SEE FORTRAN VARIABLES LIST
CASE TITLE	CASE		SEE FORTRAN VARIABLES LIST
CONTROL NUMBERS	KR(I), I=1,20		SEE FORTRAN VARIABLES LIST
U/UE TO NORM. ETA	CBAR		SEE FORTRAN VARIABLES LIST
NODAL PT. AT WHICH ETA NORMALIZED	KAPPA		SEE FORTRAN VARIABLES LIST
ETA VALUES	ETA(I),I=1, NETA		BOUNDARY LAYER NORMAL COORDINATE DEFINED BY EQ(33) OF NASA CR-1062

TITLE APPEARING IN OUTPUT	FORTRAN VARIABLE	UNITS	DEFINITION
NOSE RADIUS (FOR SPHERE BODIES ONLY)	RADNO	FT	SEE INPUT INSTRUCTIONS, GROUP 5
CONE HALF ANGLE (FOR CONIC BODIES ONLY)	CONE	DEG	SEE INPUT INSTRUCTIONS, GROUP 5
SURFACE EMITTANCE (IF KR(9) OR ANY OF THE KR9( ) =3,4,5,6)	EMISC OR EMIST		SEE INPUT INSTRUCTIONS, GROUP 6
ENTHALPY OF CHAR AT REFERENCE TEMPERATURE (IF KR(9) OR ANY OF THE KR9( ) = 4	HCARB OR HTEF	BTU/LB	SEE INPUT INSTRUCTIONS, GROUP 6
ENTHALPY OF PYROLYSIS GAS (IF KR (9) OR ANY OF THE KR9 ( )= 4	HPG	BTU/LB	SEE INPUT INSTRUCTIONS, GROUP 6
CASE (OR TIME,SEC)	TIME(I),I=1, NITEM		SEE FORTRAN VARIABLES LIST
TOTAL ENTHALPY	GE(I),I=1, NITEM	BTU/LB	TOTAL ENTHALPY FOR EACH CASE (OR TIME)
TOTAL PRESSURE	PTET(I),I=1, NITEM	ATM	TOTAL PRESSURE FOR EACH CASE (OR TIME)
INCIDENT RAD FLUX	RADFL(I), I=1,NITEM	BTU/SEC-SQ FT	REFERENCE INCIDENT RADIATION FLUX (USUALLY STAGNATION POINT VALUE)
MIX LENGTH CONST (IF KR(7) = 2)	ELCON		SEE INPUT INSTRUCTIONS, GROUP 8

TITLE APPEAR-ING IN OUTPUT	FORTRAN VARIABLE	UNITS	DEFINITION
SUBLAYER CONST YA+ (IF KR(7)=2)	YAP		SEE INPUT INSTRUCTIONS, GROUP 8
CLAUSER NUMBER (IF KR(7) = 2)	CLNUM		SEE INPUT INSTRUCTIONS, GROUP 8
TURBULENT SCHMIDT NUMBER (IF KR(7) = 2)	SCT		SEE INPUT INSTRUCTIONS, GROUP 8
TURBULENT PRANDTL NUMBER (IF KR(7) = 2)	PRT		SEE INPUT INSTRUCTIONS, GROUP 8
TRANSITION MOM. THICK. RE (IF KR(7) = 2)	RETR		SEE INPUT INSTRUCTIONS, GROUP 8

3. STANDARD OUTPUT OF PROPERTY INPUT DATA (CALLED FROM INPUT)

TITLE APPEAR-ING IN OUTPUT	FORTRAN VARIABLE	UNITS	DEFINITION
AT. NO.	KAT(J),J=1,IS		ATOMIC NUMBER
ELEMENT	(ATA(J),ATB(J), ATC(J),J=1,IS)		ELEMENT NAME
ATOMIC WT	WAT(J), J=1,IS		ATOMIC WEIGHT
RELATIVE ELEMENTAL COMPOSITIONS FOR COMPON-ENTS 1,2,3	(TK(J,I), I=1,7) J=1,IS	ATOMIC WTS/UNIT MASS	GRAM ATOMS OF ELEMENT J PER UNIT MASS IN EACH COMPONENT OF EACH MATERIAL COMBINATION

TITLE APPEARING IN OUTPUT	FORTRAN VARIABLE	UNITS	DEFINITION
CARD 1 OF THERMO DATA FOR FIRST SPECIES	(ALPT(K), JAT(K), K=1,7), AMOA,AMOB		SEE FORTRAN VARIABLES LIST
CARDS 2 AND 3 OF THERMO DATA FOR FIRST SPECIES	(RA(K),CH(KK,K) ,RC(KK,K),RD (KK,K),RE(KK, K),RF(KK,K), TU(KK,K),KPHA (K),K=1,2), FF(KK)		SEE FORTRAN VARIABLES LIST
REPEAT CARDS 1,2 AND 3 OF THERMO DATA FOR ALL SPECIES			
ELEMENT	ATA(I), ATB(I), ATC(I), I=1,IS		ELEMENTS
BASE SP	IC(I),IM(I), I=1, IS		BASE SPECIES CHOSEN FOR EACH ELEMENT
SIGMA	SIGMA		SEE INPUT INSTRUCTIONS, GROUP 11
EPOVRK	EPOVRK		SEE INPUT INSTRUCTIONS, GROUP 11
MREF	BASMOL		SEE INPUT INSTRUCTIONS, GROUP 11
FITMOL	FITMOL		SEE INPUT INSTRUCTIONS, GROUP 11
FFA	FFA		SEE INPUT INSTRUCTIONS, GROUP 11
FITGMW	FITGMW		SEE INPUT INSTRUCTIONS, GROUP 11
GGA	GGA		CONSTANT USED IN TRANSPORT PROPERTIES CALCULATIONS. ALWAYS 0.4540 IN THIS VERSION OF THE PROGRAM
SPECIES	FAMOA(KK), FAMOB(KK), KK = 1,N		SPECIES NAMES
F(I)	FF(KK), KK= 1, N		MOLECULAR DIFFUSION CORRELATION COEFFICIENTS DESCRIBED IN REFERENCE 4.
G(I)	GG(KK), KK= 1, N		QUANTITY USED IN THE BUDDENBERG-WILKE MIXTURE FORMULA FOR VISCOSITY AS DISCUSSED IN REFERENCE 5.

TITLE APPEARING IN OUTPUT	FORTRAN VARIABLE	UNITS	DEFINITION
KINETIC REACTION (IF MT GT 0)	M,M=1,MT		KINETIC REACTION NUMBER
REACTANT COEFFS (IF MT GT 0)	(FAMOA(I),FAMOB (I),(RMU(I,M), M=1,MT),I=1, IS)		SEE FORTRAN VARIABLES LIST
PRODUCT COEFFS (IF MT GT 0)	(FAMOA(I),FAMOB (I),(PMU(I,M), M=1,MT),I=1, IS)		SEE FORTRAN VARIABLES LIST
PRE-EXPONENT FACTOR (IF MT GT 0)	(FKF(M),M=1, MT),I=1,IS	LB-MOLES OF REACTANT/SEC-SQ FT	SEE FORTRAN VARIABLES LIST
ACTIVATION ENERGY (IF MT GT 0)	(EAK(M),M=1, MT),I=1,IS	CALORIES/ GM-MOLE	SEE FORTRAN VARIABLES LIST
REACTION ORDER (IF MT GT 0)	(EXK(M),M=1, MT),I=1,IS		SEE FORTRAN VARIABLES LIST

4. STANDARD CHEMISTRY OUTPUT FOR BOUNDARY LAYER EDGE EXPANSION (CALLED FROM EQUIL)

TITLE APPEARING IN OUTPUT	FORTRAN VARIABLE	UNITS	DEFINITION
CP-FROZEN	CPF	CAL/GM-DEG K	SEE FORTRAN VARIABLES LIST
CP-EQUIL	CSP	CAL/GM-DEG K	SEE FORTRAN VARIABLES LIST
DLNM/DLNT	ALF		SEE FORTRAN VARIABLES LIST
DLNM/DLNP	BETH		SEE FORTRAN VARIABLES LIST
GAMMA	GAM		SEE FORTRAN VARIABLES LIST

TITLE APPEARING IN OUTPUT	FORTRAN VARIABLE	UNITS	DEFINITION
TEMP	T	DEG K	SEE FORTRAN VARIABLES LIST
PRES	P	ATM	SEE FORTRAN VARIABLES LIST
MOL WT	WM		SEE FORTRAN VARIABLES LIST
RELATIVE MASSES OF COMPONENTS 1,2 AND 3	W		MEANINGLESS FOR BOUNDARY LAYER EDGE CALCULATIONS
ENTHALPY	HIP	CAL/GM	SEE FORTRAN VARIABLES LIST
ENTROPY	SIP	CAL/GM-DEG K	SEE FORTRAN VARIABLES LIST
DENSITY	RHR	LB/CU FT	SEE FORTRAN VARIABLES LIST
VEL	VEL	FT/SEC	SEE FORTRAN VARIABLES LIST
MACH	VMACH		SEE FORTRAN VARIABLES LIST
AREA	AREA	SQ FT/LB/SEC	MEANINGLESS FOR BOUNDARY LAYER EDGE CALCULATIONS
SPECIES	FAMOA(I),FAMOB(I),I=1,N		SEE FORTRAN VARIABLES LIST
MOLE FR.	VN(I),I=1,N		SEE FORTRAN VARIABLES LIST

5. SUMMARY TABLE OF EDGE CONDITIONS (CALLED FROM REFCON)

TITLE APPEARING IN OUTPUT	FORTRAN VARIABLE	UNITS	DEFINITION
DISTANCE	S(I),I=1,NS	FT	SEE FORTRAN VARIABLES LIST
ROKAP	ROKAP(I),I=1,NS	FT	SEE FORTRAN VARIABLES LIST
XI	XI(I),I=1,NS	(LB/SEC)**2	SEE FORTRAN VARIABLES LIST

TITLE APPEARING IN OUTPUT	FORTRAN VARIABLE	UNITS	DEFINITION
PRESSURE RATIO	PRE(I),I=1,NS		SEE FORTRAN VARIABLES LIST
STATIC PRESSURE	PE(I,1),I=1, NS	ATM	SEE FORTRAN VARIABLES LIST
EDGE VELOCITY	UE(I),I=1,NS	FT/SEC	SEE FORTRAN VARIABLES LIST
BETA	BETAM(I),I=1,NS		SEE FORTRAN VARIABLES LIST
INCIDENT RAD. FLUX	RADS(I),I=1, NS	BTU/SEC-SQ FT	SEE FORTRAN VARIABLES LIST
ENTROPY DROP	DSIP(I),I=1, NS	BTU/LB-DEG R	SEE FORTRAN VARIABLES LIST
WALL ENTHALPY (IF KR(11)=1)	HW(I,1),I=1, NS	BTU/LB	SEE FORTRAN VARIABLES LIST
WALL TEMP. (IF KR(9)=3 OR 5 OR IF KR(9)=0,1,2 WITH KR(11) =0)	TW(I,1),I=1, NS	DEG R	SEE FORTRAN VARIABLES LIST
WALL STREAM FUNCTION (IF KR(9)=0)	FW(I,1),I=1,NS		SEE FORTRAN VARIABLES LIST
MASS FLUX (IF KR(9)=2 AND KR(8)=0)	RHOVW(I,1), I=1,NS	LB/SEC-SQ FT	SEE FORTRAN VARIABLES LIST
NORMALIZED MASS FLUX (IF KR(9)=2 AND KR(8)=1)	RHOVW(I,1), I=1,NS		SEE FORTRAN VARIABLES LIST
ELEMENTAL MASS FRACTION (IF KR(9)=0 OR 1)	(SPW(K,I,1),I= 1,NS),K=1, NSPM1		SEE FORTRAN VARIABLES LIST
COMP FLUX (IF KR(9)=2 AND KR(8)=0)	(FLUXJ(K,I,1), I=1,NS), K=1,3	LB/SEC-SQ FT	SEE FORTRAN VARIABLES LIST

TITLE APPEAR-ING IN OUTPUT	FORTRAN VARIABLE	UNITS	DEFINITION
NORMALIZED COMP FLUX (IF KR(9)=2 AND KR(8)=1)	(FLUXJ(K,I,1), I=1,NS), K=1,3		SEE FORTRAN VARIABLES LIST

6. ONE-LINE-PER-ITERATION OUTPUT OF BOUNDARY LAYER ITERATION (CALLED FROM ITERAT)

TITLE APPEAR-ING IN OUTPUT	FORTRAN VARIABLE	UNITS	DEFINITION
ITS	ITS		ITERATION NUMBER
TIME	TIMD	SECONDS	ELAPSED TIME SINCE BEGINNING SOLUTION AT THIS STATION
ALPH	ALPH		NORMALIZING PARAMETER IN ETA DIRECTION
FPPW	FPPW		F(3,1)/ALPH**2, SHEAR FUNCTION AT WALL
DAMP	EASE		DAMPING FACTOR APPLIED UNIFORMLY TO ALL CORRECTIONS
MAX LINEAR ERROR	ELMM		MAXIMUM LINEAR ERROR (APPROACHES ZERO WHEN DAMPING FACTOR APPROACHES UNITY)
MAX ERROR IN MOMENTUM EQUATIONS	IFNLM,FNLEM		INDICE OF MOMENTUM EQUATION WITH MAXIMUM ERROR (I=1 AT WALL) AND VALUE OF ERROR
MAX ERROR IN ENERGY EQUATIONS	IGNLM,GNLEM	BTU/LB	INDICE OF ENERGY EQUATION WITH MAXIMUM ERROR (I=1 AT WALL) AND VALUE OF ERROR
MAX ERROR IN SPECIES EQUATIONS	(ISPNLM(K),SPNLEM(K),K=1,NSPM1)		FOR EACH BASE SPECIES, INDEX OF SPECIES EQUATION WITH MAXIMUM ERROR (I=1 AT WALL) AND VALUE OF ERROR

7. STANDARD OUTPUT FOR BOUNDARY LAYER SOLUTION (CALLED FROM OUTPUT)

TITLE APPEARING IN OUTPUT	FORTRAN VARIABLE	UNITS	DEFINITION
ALPHA	ALPH		SEE FORTRAN VARIABLES LIST
XI	XI(IS)	(LB/SEC)**2	SEE FORTRAN VARIABLES LIST
ROKAP	ROKAP(IS)	FT	SEE FORTRAN VARIABLES LIST
PRESSURE	PE(IS,1)	ATM	SEE FORTRAN VARIABLES LIST
EDGE VELOCITY	UE(IS)	FT/SEC	SEE FORTRAN VARIABLES LIST
BETA	BETA		SEE FORTRAN VARIABLES LIST
FLUX NORMALIZING PARAMETER	-1./C3	LB/SEC-SQ FT	FLUX NORMALIZING PARAMETER DEFINED BY EQ(44) OF NASA CR-1062
DIFFUSIONAL HEAT FLUX	-WALLQ/C3	BTU/SEC-SQ FT	DIFFUSIONAL HEAT FLUX TO THE WALL GIVEN BY EQ(49) OF NASA CR-1062
TOT ENTH HEAT FLUX	-(WALLQ+G(1,1)*RHOVW(IS,1))/C3	BTU/SEC-SQ FT	DIFFUSIONAL HEAT FLUX TO THE WALL LESS THE ENERGY ASSOCIATED WITH THE CONVECTION OF GAS INTO THE BOUNDARY LAYER
RERAD HEAT FLUX	(.481E-12)*EMIS*(T(1))**4.	BTU/SEC-SQ FT	RATE AT WHICH ENERGY IS RERADIATED FROM THE WALL, FOR KR(9)=3 THROUGH 6 ONLY
QCOND	QDIFU	BTU/SEC-SQ FT	ENERGY CONDUCTED INTO THE WALL DUE TO TEMPERATURE GRADIENT IN THE GAS AT THE WALL. DIFFUSIONAL FLUX NOT INCLUDED
WALL SHEAR	SHEAR	LB/SQ FT	SEE FORTRAN VARIABLES LIST
MECH REM	(W(2)+W(3)-RHOVW(IS,1))/C3	LB/SEC-SQ FT	RATE AT WHICH WALL MATERIAL IS REMOVED IN A CONDENSED STATE
PYROL GAS MASS FLUX	W(2)/C3	LB/SEC-SQ FT	RATE AT WHICH COMPONENT 2 (USUALLY PYROLYSIS GAS) IS INJECTED INTO BOUNDARY LAYER
CHAR MASS FLUX	W(3)/C3	LB)SEC-SQ FT	RATE AT WHICH COMPONENT 3 (USUALLY CHAR) IS INJECTED INTO BOUNDARY LAYER (INCLUDING CONDENSED PHASE REMOVAL)

TITLE APPEARING IN OUTPUT	FORTRAN VARIABLE	UNITS	DEFINITION
TOTAL GAS MASS FLUX	RHOVW(IS,1) /C3	LB/SEC-SQ FT	RATE AT WHICH GAS IS INJECTED INTO THE BOUNDARY LAYER
ELEMENTAL MASS DIFFUSIVE FLUXES	VJKW(I),I=1, NSP	LB/SEC-SQ FT	DIFFUSIVE MASS FLUXES OF ELEMENTS (IRRESPECTIVE OF MOLECULAR CONFIGURATION) INTO THE BOUNDARY LAYER AT THE WALL
MOM TRANS COEFF, RHO*UE*CF/2	CF	LB/SEC-SQ FT	SEE FORTRAN VARIABLES LIST
HEAT TRANS COEFF, RHO*UE*CH	CH	LB/SEC-SQ FT	SEE FORTRAN VARIABLES LIST
BLOWING PARAMETER (BASED ON CH) FOR PYROL GAS	W(2)/(C3*CH)		PYROLYSIS GAS RATE NORMALIZED BY RHOE*UE*CH
BLOWING PARAMETER (BASED ON CH) FOR CHAR	W(3)/(C3*CH)		CHAR RECESSION RATE NORMALIZED BY RHOE*UE*CH
BLOWING PARAMETER (BASED ON CH) FOR TOTAL GAS	BLOW		SEE FORTRAN VARIABLES LIST
ELEMENTAL MASS TRANSFER COEFFS, RHOE*UE*CM	CM(I),I=1, NSP	LB/SEC-SQ FT	SEE FORTRAN VARIABLES LIST
MOMENTUM THICKNESS, THETA	THMOM	FT	SEE FORTRAN VARIABLES LIST
DISPLACEMENT THICKNESS, DELSTAR	DELST	FT	SEE FORTRAN VARIABLES LIST
EFFECTIVE BODY DISPLACE	DELBD	FT	EFFECTIVE BODY DISPLACEMENT THICKNESS

TITLE APPEARING IN OUTPUT	FORTRAN VARIABLE	UNITS	DEFINITION
ENTHALPY THICKNESS, LAMBDA	THENGY	FT	SEE FORTRAN VARIABLES LIST
REYNOLDS NUMBER PER FOOT	RHOE(IS)*UE (IS)/VMUE(IS)	1/FT	
MASS THICKNESSES	THELEM(I),I=1 ,NSP	FT	SEE FORTRAN VARIABLES LIST
DISTANCE FROM WALL	Y(I),I=1,NETA	FT	ACTUAL DISTANCE FROM BODY MEASURED NORMAL TO SURFACE
ETA	ETA(I)*ALPH, I=1,NETA		CONVENTIONAL DEFINITION OF BOUNDARY LAYER NORMAL COORDINATE DEFINED BY EQ (32) OF NASA CR-1062
F	F(1,I),I=1,NETA		STREAM FUNCTION
FP(=U/UE)	F(2,I)/ALPH, I=1,NETA		VELOCITY RATIO
FPP	F(3,I)/ALPH**2, I=1,NETA		SHEAR FUNCTION (DERIVATIVE OF VELOCITY RATIO WITH RESPECT TO CONVENTIONAL ETA)
SHEAR	DUDS(I) I=1,NETA	LBF/FT**2	LOCAL SHEAR STRESS
TOTAL ENTHALPY,G	G(1,I), I=1,NETA	BTU/LB	TOTAL ENTHALPY
GP	G(2,I)/ALPH, I=1,NETA	BTU/LB	DERIVATIVE OF TOTAL ENTHALPY WITH RESPECT TO CONVENTIONAL ETA
GPP	G(3,I)/ALPH**2 ,I=1,NETA	BTU/LB	SECOND DERIVATIVE OF TOTAL ENTHALPY WITH RESPECT TO CONVENTIONAL ETA
STATIC ENTHALPY	H(I)	BTU/LB	STATIC ENTHALPY
TEMP	T(I)	DEG R	STATIC TEMPERATURE
ELEC COLL FREQ	DER(8)	1/SEC	ELECTRON COLLISION FREQUENCY

TITLE APPEARING IN OUTPUT	FORTRAN VARIABLE	UNITS	DEFINITION
DENSITY,RHO	RHO(I), I=1,NETA	LB/CU FT	DENSITY
VISCOSITY,MU	VMU(I), I=1,NETA	LB/SEC-FT	VISCOSITY
RHO*MU/(RHOE *MUE),C	CADC(I), I=1,NETA		PRODUCT OF DENSITY AND VISCOSITY NORMALIZED BY THEIR VALUES AT EDGE
SPECIFIC HEAT	CPBAR(I), I=1,NETA	BTU/LB-DEG R	FROZEN SPECIFIC HEAT
THERMAL	COND,I=1,NETA	BTU/SEC-FT-DEG R	THERMAL CONDUCTIVITY
PRANDTL NUMBER	PR(I),I=1,NETA		PRANDTL NUMBER BASED ON FROZEN SPECIFIC HEAT
MODIFIED SCHMIDT NUMBER	SC(I),I=1,NETA		REFERENCE SYSTEM SCHMIDT NUMBER DEFINED BY EQ(46) OF NASA CR-1062
MOLECULAR WEIGHT	VMW(I),I=1,NETA		MOLECULAR WEIGHT
RHOSQ*EPS/ RHOE * MUE	EPSA(I) I=1,NETA		DIMENSIONLESS EDDY VISCOSITY
MACH NUMBER	ACH		MACH NUMBER
ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA	(SP(1,I,K),I=1, NETA),K=1,NSP (SP(2,I,K)/ALPH ,I=1,NETA), K=1,NSP (SP(3,I,K)/ALPH **2,I=1,NETA), K=1,NSP		MASS FRACTIONS OF BASE SPECIES AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA (CONVENTIONAL DEFINITION SEE EQ(32) OF NASA CR-1062)
MOLE FRACTIONS	(FR(J,I),I=1, NETA),J=1, NSPEC		MOLE FRACTIONS

SECTION V

SAMPLE CASES

A total of three sample cases are discussed in this section. Input cards and sample output for each case are shown in each subsection.

1. SAMPLE CASE 1 - FLAT PLATE IN AIR BOUNDARY LAYER

The first sample case consists of a cooled nonablating flat plate in a supersonic air boundary layer. This problem is perhaps overly simple for a sophisticated nonsimilar general chemistry program such as this one, however it does illustrate the basic features of the program in a direct fashion. A nonsimilar solution is called for on a planar sharp body in laminar flow. Wall temperature is assigned at $530^{o}R$ with wall mass fluxes set to zero everywhere along the plate. Two cases are considered: $P_o = 1.0$ atmospheres and $P_o = 10.0$ atmospheres. Stagnation enthalpy is 1000 Btu/lb for both cases. Four stations along the plate are analyzed (1, 2, 6, and 12 inches) and seven nodes are assigned through the boundary layer. Only two elements (N and O) are required to describe the air boundary layer, however, five candidate species (N, O, NO, N_2, O_2) are provided in the thermochemical data tables. For both cases considered, the air is assumed to expand to a pressure ratio P/P_o of 0.1278 corresponding to an edge Mach number of approximately 2.0.

a. Input cards for Sample Case Number 1

```
10104300210002000000 NONABLATING FLAT PLATE IN AIR

 2
 2
-1.       2.
 4
.08333    .16667    .5        1.0
 7
0.0       0.5       1.0       1.5       2.0       3.0       5.0
 5  0.8
1.0       10.0
1000.     1000.
0.0       0.0
100.
  2
  7NITROGEN     14.008    -.765
  8OXYGEN       16.000    -.235
  1  7  0  0  0  0  0  0  0  0  0  0  0  0JANAF 03/61                    N
 112965+6 134370+5 486944+1 383516-4 958460+5 480900+2  500. 3000.1   0.N
 112965+6 134370+5 428957+1 240844-3-417273+6 480900+2 3000. 5000.1   0.N
  1  8  0  0  0  0  0  0  0  0  0  0  0  0JANAF 06/62                    O
 595590+5 135220+5 497228+1 380768-5 154749+5 500960+2  500. 3000.1   0.O
 595590+5 135220+5 657489+1-224268-3-891782+7 500960+2 3000. 5000.1   0.O
  1  7  1  8  0  0  0  0  0  0  0  0  0  0JANAF 06/63                   NO
 215800+5 227000+5 877623+1 899031-4-789656+6 688490+2  500. 3000.1   0.NO
 215800+5 227000+5 916260+1 657885-5-212519+7 688490+2 3000. 5000.1   0.NO
  2  7  0  0  0  0  0  0  0  0  0  0  0  0JANAF 03/61                   N2
 000000-0 221650+5 862699+1 116090-3-103715+7 637650+2  500. 3000.1   0.N2
 000000-0 221650+5 984175+1-116232-3-612728+7 637650+2 3000. 5000.1   0.N2
  2  8  0  0  0  0  0  0  0  0  0  0  0  0JANAF 03/61                   O2
 000000-0 234460+5 804370+1 510872-3-152718+6 679730+2  500. 3000.1   0.O2
 000000-0 234460+5 103071+2 290991-4-783079+7 679730+2 3000. 5000.1   0.O2

.1278     .1278     .1278     .1278
```

(3 blank cards)

```
530.      530.      530.      530.
```

(5 blank cards)

b. Output from Sample Case Number 1

```
              BOUNDARY LAYER INTEGRAL MATRIX PROGRAM (BLIMP)

         AEROTHERM CORPORATION,PALO ALTO,CALIF (RMK,EPB)  24 OCT 69 15:31:50

CASE  NONABLATING FLAT PLATE IN AIR

         CONTROL NUMBERS  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20

                          1  0  1  0  4  3  0  0  2  1  0  0  0  2  0  0  0  0  0  0

         PUNCH CONTROL
         IDENT  JSPEC
                  -0

   U/UE TO        NODAL PT.                              ETA VALUES
  NORM, ETA       AT WHICH
                  ETA NORM,
   8.000-01          5         0.000     5.000-01  1.000+00  1.500+00  2.000+00  3.000+00  5.000+00

CASE                         1.00000+00  2.00000+00

TOTAL ENTHALPY,BTU/LB        1.00000+03  1.00000+03

TOTAL PRESSURE,ATM           1.00000+00  1.00000+01

INCIDENT RAD FLUX,B/SF2      0.00000     0.00000
```

```
      CASE  1 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -  24 OCT 69 15:31:50

RELATIVE ELEMENTAL COMPOSITIONS, ATOMIC WTS/UNIT MASS
   AT,NO.  ELEMENT    ATOMIC WT    EDGE GAS   PYRO.GAS 1    CHAR 1    PYRO.GAS 2    CHAR 2    PYRO.GAS 3    CHAR 3
     7    NITROGEN    14.00800    .0546117   -.0000000   -.0000000   -.0000000   -.0000000   -.0000000   -.0000000
     8    OXYGEN      16.00000    .0146875   -.0000000   -.0000000   -.0000000   -.0000000   -.0000000   -.0000000

  THERMODYNAMIC PROPERTY CURVE-FIT DATA (SEE MANUAL FOR FORMAT)


    ELEMENT  NITROGEN    OXYGEN
    BASE SP      N          O


  MOLECULAR TRANSPORT PROPERTIES
    VISCOSITY ....., BUDDENBERG - WILKE MIXTURE FORMULA WITH MU(I) CALCULATED ON
                     THE BASIS OF D(I,I) = DBAR/G(I)**2

    THERMAL CONDUCTIVITY ...... MASON - SAXENA MIXTURE FORMULA WITH EUCKEN CORRECTION

    DIFFUSION COEFFICIENTS ...... D(I,J) = DBAR/(F(I)*F(J)) WITH DBAR BASED ON
                     SIGMA =   3.4670, EPOVRK =  106.7000, AND MREF =  32.0000


      METHODS EMPLOYED

       0 CONDENSED PHASE, VALUES FOR F(I) AND G(I) SET EQUAL TO 1.E+10

       1 VALUES FOR F(I) (OR G(I)) INPUT DIRECTLY

       2 VALUES FOR F(I) (OR G(I)) CALCULATED BY  F(I) =(M(I)/FITMOL)**FFA AND
         G(I) = (M(I)/FITGMW)**GGA WHERE M(I) IS SPECIES MOLECULAR WEIGHT,
         FITMOL =  26.7000, AND FFA =  .4890, FITGMW =  24.3000, AND GGA =  .4540

       3 VALUES FOR G(I) CALCULATED BY G(I) = SQRT(DBAR/D(I,I)) = (SIGMA(I)/SIGMA)
         * (EPS(I)/EPOVRK) **0.0795 * (M(I)/MREF) **0.25 WHERE SIGMA(I) AND EPS(I)
         ARE GIVEN WITH THERMODYNAMIC DATA

      SPECIES    F(I) METHOD G(I) METHOD        SPECIES    F(I) METHOD G(I) METHOD
      N          .729   2    .779   2           O          .778   2    .827   2
      NO        1.059   2   1.101   2           N2        1.024   2   1.067   2
      O2        1.093   2   1.133   2

  STAGNATION SOLUTION FOLLOWED BY BOUNDARY-LAYER EDGE EXPANSION


        CP-FROZEN    CP-EQUIL   DLNM/DLNT   DLNM/DLNP     GAMMA
        .30420-00   .34625-00  -.10340-01   .37795-03   .12543+01

      TEMP = 2235.7493 DEG-K      PRES =  1.0000 ATM     MOL WT = 28.8385340
   RELATIVE MASSES OF COMPONENTS 1,2 AND 3     .00000       .00000       .00000
       ENTHALPY =    .5555556+03 CAL/GM    ENTROPY =   .21925+01 CAL/GM-DEG K
       DENSITY =    .981198-02 LB/CUFT
   VEL =    .000    FT/SEC   MACH =  -.000      AREA =   .000    SQFT/LB/SEC
```

```
SPECIES   MOLE FR.       SPECIES   MOLE FR.       SPECIES   MOLE FR.
N          .16620-07     O          .15141-02     NO         .14150-01
N2         .78038-00     O2         .20395-00


      CP-FROZEN    CP-EQUIL   DLNM/DLNT   DLNM/DLNP     GAMMA
        .28988-00   .29351-00  -.18533-04   .37253-06   .13064+01

    TEMP = 1420.6675 DEG-K     PRES =   .1278 ATM     MOL WT = 28.8603590
RELATIVE MASSES OF COMPONENTS 1,2 AND 3    .00000       .00000       .00000
     ENTHALPY =   .2994989+03 CAL/GM    ENTROPY =   .21925+01 CAL/GM-DEG K
     DENSITY =   .197491-02 LB/CUFT
VEL =   .480+04 FT/SEC    MACH =   .200+01    AREA =   .105+00 SQFT/LB/SEC

SPECIES   MOLE FR.       SPECIES   MOLE FR.       SPECIES   MOLE FR.
N          .17561-13     O          .16558-05     NO         .88598-03
N2         .78761-00     O2         .21150-00


      CP-FROZEN    CP-EQUIL   DLNM/DLNT   DLNM/DLNP     GAMMA
        .28988-00   .29351-00  -.17971-04   .40233-06   .13064+01

    TEMP = 1420.6675 DEG-K     PRES =   .1278 ATM     MOL WT = 28.8603590
RELATIVE MASSES OF COMPONENTS 1,2 AND 3    .00000       .00000       .00000
     ENTHALPY =   .2994989+03 CAL/GM    ENTROPY =   .21925+01 CAL/GM-DEG K
     DENSITY =   .197491-02 LB/CUFT
VEL =   .480+04 FT/SEC    MACH =   .200+01    AREA =   .105+00 SQFT/LB/SEC

SPECIES   MOLE FR.       SPECIES   MOLE FR.       SPECIES   MOLE FR.
N          .17561-13     O          .16558-05     NO         .88598-03
N2         .78761-00     O2         .21150-00


      CP-FROZEN    CP-EQUIL   DLNM/DLNT   DLNM/DLNP     GAMMA
        .28988-00   .29351-00  -.18526-04   .40233-06   .13064+01

    TEMP = 1420.6675 DEG-K     PRES =   .1278 ATM     MOL WT = 28.8603580
RELATIVE MASSES OF COMPONENTS 1,2 AND 3    .00000       .00000       .00000
     ENTHALPY =   .2994989+03 CAL/GM    ENTROPY =   .21925+01 CAL/GM-DEG K
     DENSITY =   .197491-02 LB/CUFT
VEL =   .480+04 FT/SEC    MACH =   .200+01    AREA =   .105+00 SQFT/LB/SEC

SPECIES   MOLE FR.       SPECIES   MOLE FR.       SPECIES   MOLE FR.
N          .17561-13     O          .16558-05     NO         .88598-03
N2         .78761-00     O2         .21150-00


      CP-FROZEN    CP-EQUIL   DLNM/DLNT   DLNM/DLNP     GAMMA
        .28988-00   .29351-00  -.18518-04   .41723-06   .13064+01

    TEMP = 1420.6675 DEG-K     PRES =   .1278 ATM     MOL WT = 28.8603580
```

```
RELATIVE MASSES OF COMPONENTS 1,2 AND 3    .00000      .00000      .00000
     ENTHALPY =   .2994989+03 CAL/GM    ENTROPY =   .21925+01 CAL/GM-DEG K
     DENSITY =   .197491-02 LB/CUFT
VEL =   .480+04 FT/SEC   MACH =   .200+01   AREA =   .105+00 SQFT/LB/SEC

SPECIES   MOLE FR.        SPECIES   MOLE FR.        SPECIES   MOLE FR.
N          .17561-13      O          .16558-05      NO         .88598-03
N2         .78761-00      O2         .21150-00
```

DISTANCE,FT	.83333-01	.16667-00	.50000-00	.10000+01
ROKAP	.10000+01	.10000+01	.10000+01	.10000+01
XI,(LB/SEC)**2	.24687-04	.49377-04	.14813-03	.29626-03
PRESSURE RATIO	.12780-00	.12780-00	.12780-00	.12780-00
STATIC PRESSURE,ATM	.12780-00	.12780-00	.12780-00	.12780-00
EDGE VELOCITY,FT/SEC	.48034+04	.48034+04	.48034+04	.48034+04
BETA	-.21177-07	-.30708-07	.10165-06	.00000
INCIDENT RADIATION FLUX	.00000	.00000	.00000	.00000
ENTROPY DROP,BTU/LB R	.00000	.00000	.00000	.00000
-1/FLUX NORM,PARAMETER	-.23718+02	-.33544+02	-.58099+02	-.82164+02
WALL TEMPERATURE,DEG R	.53000+03	.53000+03	.53000+03	.53000+03
COMP FLUX,LB/SEC FT**2	-.00000	-.00000	-.00000	-.00000
COMP FLUX,LB/SEC FT**2	-.00000	-.00000	-.00000	-.00000
COMP FLUX,LB/SEC FT**2	-.00000	-.00000	-.00000	-.00000

CASE 1 - - - - - - - - - - - - - STREAMWISE DIMENSION .83330-01 FEET - - - -24 OCT 69 15131150

ITERATED VALUES

ITS	TIME	ALPH	FPP.	DAMP	MAX.LIN ERROR	MAX.ERRORS IN CONSERVATION EQS. MOMENTUM		ENERGY		N		
1	1,389	1.800	.5548	,2602	3.-01	5	1.1+00	2	8.3+02	2	-1.2-05	0
2	1,842	1.620	.4709	,2952	3.-01	5	8.0-01	2	5.8+02	2	2.6-06	0
3	2,299	1.458	.3974	,3575	2.-01	5	5.3-01	2	3.9+02	2	-1.5-05	0
4	2,747	1.312	.3397	,4610	1.-01	9	-3.3-01	2	2.3+02	2	2.3-05	0
5	3,193	1.181	.3042	,6678	6.-02	9	-1.8-01	2	1.1+02	2	-1.2-05	0
6	3,639	1.103	.2866	1,0000	2.-02	5	6.7-02	2	5.2+01	2	1.6-04	0
7	4,051	1.099	.2904	1,0000	6.-08	5	-4.5-03	2	-3.7+00	2	-1.7-04	0
8	4,363	1.099	.2903	1,0000	2.-08	6	2.8-04	3	2.8-01	2	-9.3-05	0
9	4,676	1.099	.2903	1,0000	1.-08	6	2.5-05	3	2.4-02	2	1.3-04	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC	RERAD SQ FT)	QCOND
1,099+00	2.469-05	1,000+00	1.278-01	4.803+03	0.000	4.216-02	2.262+01	2.262+01	0.000	2.262+01

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC	CHAR SQ FT)	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR NITROGEN	OXYGEN
3,125+00	0.000	0,000	0.000	0.000	5,557-06	-5,557-06

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR NITROGEN	OXYGEN
2,093-02	2.436-02	0,000	0.000	0.000	-1.235+00	-1,235+00

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR NITROGEN	OXYGEN
3,677-04	4.095-04	4,095-04	4.279-04	3,038+05	5,497-03	5,491-03

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0,000	0.000	0,000	0.000	2,903-01	3.125+00	7,125+01	2,155+02	1.793+02	7.125+01	5.300+02	4,330+10
1.038-04	5.495-01	4,905-02	1.881-01	3,942-01	3,104+00	2.167+02	3,140+02	8,443+01	2,004+02	1.325+03	2.738+10
3,547-04	1.099+00	2,129-01	4.101-01	4,140-01	2,935+00	4.020+02	3,604+02	-1,301+01	3.245+02	1.804+03	2,347+10
6,706-04	1.648+00	4,985-01	6.253-01	3,694-01	2.470+00	5,981+02	3,533+02	-1,358+02	4.179+02	2.143+03	2.154+10
1,030-03	2 198+00	8,927-01	8.000-01	2,664-01	1.726+00	7,717+02	2,786+02	-1,897+02	4.768+02	2,350+03	2.056+10
1,810-03	297+00	1,890+00	9.752-01	5.251-02	3.324-01	9.633+02	7,015+01	-8,215+01	5.251+02	2,516+03	1,987+10
3,433-03	5.495+00	381+00	1.000+00	0.000	0.000	1,000+03	0.000	1,831+01	5.392+02	2,552+03	1.973+10

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0,000	9.529-03	1,107-05	1.710+00	-4.291-02	-6,915-07	6,870-01	6,940-01	2,886+01	0.000	0.000
1,038-04	3.810-03	2,025-05	1.251+00	2.454+01	7,252-06	6,854-01	6,940-01	2,886+01	0.000	5.070-01
3,547-04	2.799-03	2,482-05	1.126+00	2.723-01	9.857-06	6,855-01	6,940-01	2,886+01	0.000	9.658-01
6,706-04	2.357-03	2,779-05	1.062+00	2,821-01	1.144-05	6,856-01	6,940-01	2,886+01	0.000	1.360+00
1,030-03	2.149-03	2,954-05	1.029+00	2,864-01	1.234-05	6,857-01	6,940-01	2,886+01	0.000	1.666+00
1,810-03	2.007-03	3,090-05	1.006+00	2,892-01	1,303-05	6,858-01	6,940-01	2,886+01	0.000	1.967+00
3,433-03	1.979-03	3,119-05	1.001+00	2.898-01	1,318-05	6,858-01	6,941-01	2,886+01	0.000	2.004+00

DISTANCE FROM WALL,FT

	0.000	1.038-04	3.547-04	6.796-04	1.030-03	1.810-03	3.433-03
ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA							
N	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01
	-1.618-05	1.348-07	-2.905-07	-4.987-08	-6.851-09	5.789-08	0.000
	2.969-05	-7.739-07	4.379-07	7.829-08	5.892-08	-6.861-08	1.593-08
O	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01
	1.618-05	-1.348-07	2.905-07	4.987-08	6.851-09	-5.789-08	-0.000
	-2.969-05	7.739-07	-4.379-07	-7.329-08	-5.892-08	6.861-08	-1.593-08
MOLE FRACTIONS							
N	1.000-30	9.217-31	8.371-22	7.029-18	4.993-16	9.081-15	1.610-14
O	1.000-30	3.833-15	2.155-10	2.602-08	2.501-07	1.167-06	1.581-06
NO	1.500-14	7.191-07	3.631-05	2.015-04	4.518-04	7.822-04	8.716-04
N2	7.881-01	7.881-01	7.880-01	7.880-01	7.878-01	7.877-01	7.876-01
O2	2.119-01	2.119-01	2.119-01	2.118-01	2.117-01	2.116-01	2.115-01

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CASE  2 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -  24 OCT 69 15:31:55

     CP-FROZEN    CP-EQUIL   DLNM/DLNT    DLNM/DLNP      GAMMA
      .30426-00   .33342-00  -.34015-02   .12468-03    .12623+01

   TEMP = 2242.2928 DEG-K       PRES = 10.0000 ATM      MOL WT = 28.8531820
RELATIVE MASSES OF COMPONENTS 1,2 AND 3      .00000          .00000         .00000
     ENTHALPY =    .5555556+03 CAL/GM      ENTROPY =    .20340+01 CAL/GM-DEG K
     DENSITY =    .978831-01 LB/CUFT
VEL =    .000     FT/SEC     MACH =  -.000       AREA =    .000     SQFT/LB/SEC

SPECIES    MOLE FR.        SPECIES    MOLE FR.        SPECIES    MOLE FR.
N           .56687-03      O            .49902-03     NO          .14373-01
N2          .78067-00      02           .20445-00


     CP-FROZEN    CP-EQUIL   DLNM/DLNT    DLNM/DLNP      GAMMA
      .28988-00   .29346-00  -.51436-05   .10431-06    .13065+01

   TEMP = 1420.3238 DEG-K       PRES =  1.2780 ATM      MOL WT = 28.8603750
RELATIVE MASSES OF COMPONENTS 1,2 AND 3      .00000          .00000         .00000
     ENTHALPY =    .2993956+03 CAL/GM      ENTROPY =    .20340+01 CAL/GM-DEG K
     DENSITY =    .197539-01 LB/CUFT
VEL =    .480+04 FT/SEC     MACH =    .200+01     AREA =    .105-01 SQFT/LB/SEC

SPECIES    MOLE FR.        SPECIES    MOLE FR.        SPECIES    MOLE FR.
N           .54992-14      O            .52090-06     NO          .88434-03
N2          .78761-00      02           .21150-00


     CP-FROZEN    CP-EQUIL   DLNM/DLNT    DLNM/DLNP      GAMMA
      .28988-00   .29346-00  -.61441-05   .10431-06    .13065+01

   TEMP = 1420.3238 DEG-K       PRES =  1.2780 ATM      MOL WT = 28.8603750
RELATIVE MASSES OF COMPONENTS 1,2 AND 3      .00000          .00000         .00000
     ENTHALPY =    .2993956+03 CAL/GM      ENTROPY =    .20340+01 CAL/GM-DEG K
     DENSITY =    .197539-01 LB/CUFT
VEL =    .480+04 FT/SEC     MACH =    .200+01     AREA =    .105-01 SQFT/LB/SEC

SPECIES    MOLE FR.        SPECIES    MOLE FR.        SPECIES    MOLE FR.
N           .54992-14      O            .52090-06     NO          .88434-03
N2          .78761-00      02           .21150-00


     CP-FROZEN    CP-EQUIL   DLNM/DLNT    DLNM/DLNP      GAMMA
      .28988-00   .29346-00  -.51486-05   .13411-06    .13065+01

   TEMP = 1420.3238 DEG-K       PRES =  1.2780 ATM      MOL WT = 28.8603750
RELATIVE MASSES OF COMPONENTS 1,2 AND 3      .00000          .00000         .00000
     ENTHALPY =    .2993956+03 CAL/GM      ENTROPY =    .20340+01 CAL/GM-DEG K
     DENSITY =    .197539-01 LB/CUFT
VEL =    .480+04 FT/SEC     MACH =    .200+01     AREA =    .105-01 SQFT/LB/SEC

SPECIES    MOLE FR.        SPECIES    MOLE FR.        SPECIES    MOLE FR.
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N          .54992-14     O            .52090-06     NO          .88434-03
N2         .78761-00     O2           .21150-00


     CP-FROZEN    CP-EQUIL   DLNM/DLNT   DLNM/DLNP     GAMMA
      .28988-00   .29346-00  -.62384-05   .13411-06    .13065+01

    TEMP = 1420.3238 DEG-K      PRES =  1.2780 ATM      MOL WT = 28.8603750
RELATIVE MASSES OF COMPONENTS 1,2 AND 3     .00000        .00000       .00000
     ENTHALPY =    .2993956+03 CAL/GM     ENTROPY =   .20340+01 CAL/GM-DEG K
     DENSITY =    .197539-01 LB/CUFT
VEL =    .480+04 FT/SEC    MACH =    .200+01    AREA =   .105-01 SQFT/LB/SEC

SPECIES    MOLE FR.        SPECIES    MOLE FR.        SPECIES    MOLE FR.
N           .54992-14      O           .52090-06      NO          .88434-03
N2          .78761-00      O2          .21150-00
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DISTANCE,FT	.83330-01	.16667-00	.50000-00	.10000+01
ROKAP	.10000+01	.10000+01	.10000+01	.10000+01
XI,(LB/SEC)**2	.24694-03	.49391-03	.14817-02	.29634-02
PRESSURE RATIO	.12780-00	.12780-00	.12780-00	.12780-00
STATIC PRESSURE,ATM	.12780+01	.12780+01	.12780+01	.12780+01
EDGE VELOCITY,FT/SEC	.48044+04	.48044+04	.48044+04	.48044+04
BETA	-.12386-06	-.87872-07	.39383-06	-.20327-06
INCIDENT RADIATION FLUX	.00000	.00000	.00000	.00000
ENTROPY DROP,BTU/LB R	.00000	.00000	.00000	.00000
-1/FLUX NORM,PARAMETER	-.74993+01	-.10606+02	-.18370+02	-.25979+02
WALL TEMPERATURE,DEG R	.53000+03	.53000+03	.53000+03	.53000+03
NORMALIZED COMP FLUX	.00000	.00000	.00000	.00000
NORMALIZED COMP FLUX	.00000	.00000	.00000	.00000
NORMALIZED COMP FLUX	.00000	.00000	.00000	.00000

CASE 2 - - - - - - - - - - - STREAMWISE DIMENSION .83330-01 FEET - - - -24 OCT 69 15:31:55

ITERATED VALUES

ITS	TIME	ALPH	FPP	DAMP	MAX.LIN ERROR		MAX.ERRORS IN CONSERVATION EQS. MOMENTUM		ENERGY		N	
1	.973	1.099	.2933	.4999	6.-08	6	-3.1-04	3	-3.0-01	2	5.7-05	0
2	1.295	1.099	.29041	.0000	2.-08	6	-1.7-04	3	-1.6-01	2	2.1-05	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC	RERAD SQ FT)	QCOND
1.099+00	2.469-04	1.000+00	1.278+00	4.894+03	0.000	1.333-01	7.155+01	7.155+01	0.000	7.154+01

WALL SHEAR (LB/SQ FT)	MASS FLUXES MECH REM	PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR NITROGEN	OXYGEN
9.888+00	0.000	0.000	0.000	0.000	2.952-06	-2.952-06

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR NITROGEN	OXYGEN
6.622-02	7.704-02	0.000	0.000	0.000	-3.001-01	-3.001-01

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR NITROGEN	OXYGEN
1.164-04	1.281-04	1.281-04	1.354-04	3.039+06	-5.567-03	-5.568-03

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	0.000	0.000	2.904-01	9.888+00	7.125+01	2.156+02	1.794+02	7.125+01	5.300+02	4.330+11
3.281-05	5.495-01	4.908-02	1.881-01	3.944-01	9.824+00	2.168+02	3.142+02	8.404+01	2.003+02	1.326+03	2.738+11
1.121-04	1.099+00	2.130-01	4.102-01	4.139-01	9.286+00	4.022+02	3.604+02	-1.323+01	3.245+02	1.801+03	2.349+11
2.118-04	1.649+00	4.987-01	6.254-01	3.692-01	7.815+00	5.982+02	3.531+02	-1.358+02	4.179+02	2.137+03	2.157+11
3.250-04	2.198+00	8.929-01	8.000-01	2.662-01	5.461+00	7.717+02	2.785+02	-1.895+02	4.767+02	2.343+03	2.060+11
5.711-04	3.297+00	1.890+00	9.752-01	5.256-02	1.053+00	9.633+02	7.019+01	-8.217+01	5.249+02	2.509+03	1.990+11
1.084-03	5.495+00	4.082+00	1.000+00	0.000	0.000	1.000+03	0.000	1.831+01	5.390+02	2.557+03	1.971+11

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	9.529-02	1.107-05	1.710+00	-4.292-02	-6.915-07	6.870-01	6.940-01	2.886+01	0.000	0.000
3.281-05	3.810-02	2.025-05	1.251+00	2.454-01	7.253-06	6.854-01	6.940-01	2.886+01	0.000	5.073-01
1.121-04	2.804-02	2.479-05	1.127+00	2.722-01	9.841-06	6.855-01	6.940-01	2.886+01	0.000	9.671-01
2.118-04	2.363-02	2.774-05	1.063+00	2.820-01	1.141-05	6.856-01	6.940-01	2.886+01	0.000	1.362+00
3.250-04	2.156-02	2.948-05	1.030+00	2.863-01	1.231-05	6.857-01	6.940-01	2.886+01	0.000	1.669+00
5.711-04	2.013-02	3.084-05	1.006+00	2.891-01	1.300-05	6.858-01	6.940-01	2.886+01	0.000	1.970+00
1.084-03	1.975-02	3.123-05	9.999-01	2.899-01	1.320-05	6.858-01	6.941-01	2.886+01	0.000	2.002+00

DISTANCE FROM WALL,FT

	0.000	3.281-05	1.121-04	2.118-04	3.250-04	5.711-04	1.084-03

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

N	7.650-01	7.650-01	7.650-01	.650-01	7.650-01	7.650-01	7.650-01
	-3.613-05	2.308-07	-2.747-07	1.165-07	4.221-08	2.500-08	0.000

	6.617-05	-9.199-07	7.119-07	-1.353-07	-1.567-08	-2.333-08	5.856-10
O	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01
	3.613-05	-2.308-07	2.747-07	-1.165-07	-4.221-08	-2.500-08	-0.000
	-6.617-05	9.199-07	-7.119-07	1.353-07	1.567-08	2.333-08	-5.856-10

MOLE FRACTIONS

N	1.000-30	2.931-31	2.387-22	1.945-18	1.366-16	2.547-15	5.535-15
O	1.000-30	1.216-15	6.451-11	7.666-09	7.323-08	3.462-07	5.227-07
NO	1.500-16	7.198-07	3.561-05	1.965-04	4.396-04	7.646-04	8.855-04
N2	7.881-01	7.881-01	7.880-01	7.880-01	7.878-01	7.877-01	7.876-01
O2	2.119-01	2.119-01	2.119-01	2.118-01	2.117-01	2.116-01	2.115-01

CASE 1 - - - - - - - - - - - - STREAMWISE DIMENSION .16667-00 FEET - - - -24 OCT 69 15:31:56

ITERATED VALUES

ITS	TIME	ALPH	FPPW	DAMP	MAX.LIN. ERROR	MAX.ERRORS IN CONSERVATION EQS. MOMENTUM	ENERGY	N	
1	.667	1.099	.2903	.4999	6.-08	6 -3.0-04	3 -3.0-01	2 3.5-05	0
2	.985	1.099	.2904	1.0000	6.-08	6 -1.6-04	3 -1.6-01	2 4.3-05	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC	RERAD SQ FT)	QCOND
1.099+00	4.938-05	1.000+00	1.278-01	4.803+03	0.000	2.981-02	1.600+01	1.600+01	0.000	1.600+01

WALL SHEAR (LB/SQ FT)	MASS FLUXES MECH REM	PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR NITROGEN	OXYGEN
2.210+00	0.000	0.000	0.000	0.000	1.363-06	-1.363-06

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR NITROGEN	OXYGEN
1.481-02	1.723-02	0.000	0.000	0.000	-1.212-01	-1.212-01

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR NITROGEN	OXYGEN
5.200-04	5.728-04	5.728-04	6.052-04	3.038+05	-6.338-04	-6.364-04

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	0.000	0.000	2.904-01	2.210+00	7.125+01	2.156+02	1.794+02	7.125+01	5.300+02	4.330+10
1.467-04	5.495-01	4.907-02	1.881-01	3.944-01	2.196+00	2.168+02	3.142+02	8.409+01	2.005+02	1.326+03	2.738+10
5.013-04	1.099+00	2.130-01	4.102-01	4.139-01	2.076+00	4.021+02	3.604+02	-1.317+01	3.246+02	1.801+03	2.349+10
9.471-04	1.648+00	4.986-01	6.254-01	3.693-01	1.747+00	5.982+02	3.531+02	-1.358+02	4.179+02	2.137+03	2.156+10
1.454-03	2.198+00	8.928-01	8.000-01	2.663-01	1.221+00	7.717+02	2.785+02	-1.896+02	4.768+02	2.343+03	2.059+10
2.554-03	3.297+00	1.890+00	9.752-01	5.255-02	2.354-01	9.633+02	7.019+01	-8.219+01	5.251+02	2.509+03	1.990+10
4.848-03	5.495+00	4.081+00	1.000+00	0.000	0.000	1.000+03	0.000	1.831+01	5.392+02	2.558+03	1.971+10

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	9.529-03	1.107-05	1.710+00	-4.292-02	-6.915-07	6.870-01	6.940-01	2.886+01	0.000	0.000
1.467-04	3.810-03	2.025-05	1.251+00	2.454-01	7.253-06	6.854-01	6.940-01	2.886+01	0.000	5.072-01
5.013-04	2.804-03	2.479-05	1.127+00	2.722-01	9.841-06	6.855-01	6.940-01	2.886+01	0.000	9.668-01
9.471-04	2.363-03	2.775-05	1.063+00	2.820-01	1.141-05	6.856-01	6.940-01	2.886+01	0.000	1.362+00
1.454-03	2.155-03	2.948-05	1.030+00	2.863-01	1.231-05	6.857-01	6.940-01	2.886+01	0.000	1.669+00
2.554-03	2.012-03	3.084-05	1.006+00	2.891-01	1.301-05	6.858-01	6.940-01	2.886+01	0.000	1.970+00
4.848-03	1.975-03	3.123-05	9.999-01	2.899-01	1.320-05	6.858-01	6.941-01	2.886+01	0.000	2.002+00

DISTANCE FROM WALL,FT

	0.000	1.467-04	5.013-04	9.471-04	1.454-03	2.554-03	4.848-03

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

N	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01
	-4.110-05	-3.775-07	3.667-07	1.023-07	-6.085-08	2.016-08	0.000

	7.412-05	1.354-06	-4.811-07	-2.970-07	7.372-08	1.687-08	-3.522-08
O	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01
	4.110-05	3.775-07	-3.667-07	-1.023-07	6.085-08	-2.016-08	-0.000
	-7.412-05	-1.354-06	4.811-07	2.970-07	-7.372-08	-1.687-08	3.522-08

MOLE FRACTIONS

N	1.000-30	9.271-31	7.576-22	6.186-18	4.352-16	8.133-15	1.767-14
O	1.000-30	3.845-15	2.044-10	2.432-08	2.325-07	1.100-06	1.662-06
NO	1.500-16	7.199-07	3.563-05	1.967-04	4.402-04	7.661-04	8.871-04
N2	7.881-01	7.881-01	7.880-01	7.880-01	7.878-01	7.877-01	7.876-01
O2	2.119-01	2.119-01	2.119-01	2.118-01	2.117-01	2.116-01	2.115-01

CASE 2 - - - - - - - - - - - - STREAMWISE DIMENSION .16667-00 FEET - - - -24 OCT 69 15:31:58

ITERATED VALUES

ITS	TIME	ALPH	FPP	DAMP	MAX.LIN ERROR		MAX.ERRORS IN CONSERVATION EQS. MOMENTUM		ENERGY		N	
1	.627	1.099	.2904	.4997	2.-09	6	1.3-05	2	2.2-02	2	-1.2-04	0

ALPHA	XI (LB /SEC)**2	NOKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC SQ FT)	RERAD	QCOND
1.099+00	4.939-04	1.000+00	1.278+00	4.804+03	0.000	9.429-02	5.060+01	5.060+01	0.000	5.060+01

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR NITROGEN	OXYGEN
6.991+00	0.000	0.000	0.000	0.000	-1.164-05	1.164-05

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR NITROGEN	OXYGEN
4.682-02	5.448-02	0.000	0.000	0.000	3.784+00	3.793+00

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR NITROGEN	OXYGEN
1.644-04	1.812-04	1.812-04	1.914-04	3.039+06	1.750-04	1.754-04

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	0.000	0.000	2.904-01	6.991+00	7.125+01	2.156+02	1.794+02	7.125+01	5.300+02	4.330+11
4.641-05	5.495-01	4.908-02	1.881-01	3.944-01	6.946+00	2.168+02	3.142+02	8.405+01	2.005+02	1.326+03	2.738+11
1.585-04	1.099+00	2.130-01	4.102-01	4.139-01	6.566+00	4.022+02	3.604+02	-1.324+01	3.246+02	1.801+03	2.349+11
2.995-04	1.649+00	4.987-01	6.254-01	3.692-01	5.526+00	5.982+02	3.531+02	-1.358+02	4.179+02	2.137+03	2.156+11
4.597-04	2.198+00	8.929-01	8.000-01	2.662-01	3.861+00	7.717+02	2.785+02	-1.895+02	4.767+02	2.343+03	2.060+11
8.077-04	3.297+00	1.890+00	9.752-01	5.256-02	7.448-01	9.633+02	7.019+01	-8.217+01	5.249+02	2.509+03	1.990+11
1.533-03	5.495+00	4.082+00	1.000+00	0.000	0.000	1.000+03	0.000	1.831+01	5.390+02	2.557+03	1.971+11

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	9.529-02	1.107-05	1.710+00	-4.292-02	-6.916-07	6.870-01	6.940-01	2.886+01	0.000	0.000
4.641-05	3.810-02	2.025-05	1.251+00	2.455-01	7.254-06	6.854-01	6.940-01	2.886+01	0.000	5.073-01
1.585-04	2.803-02	2.479-05	1.127+00	2.722-01	9.842-06	6.855-01	6.940-01	2.886+01	0.000	9.670-01
2.995-04	2.363-02	2.774-05	1.063+00	2.820-01	1.141-05	6.856-01	6.940-01	2.886+01	0.000	1.362+00
4.597-04	2.156-02	2.948-05	1.030+00	2.863-01	1.231-05	6.857-01	6.940-01	2.886+01	0.000	1.669+00
8.077-04	2.013-02	3.084-05	1.006+00	2.891-01	1.300-05	6.858-01	6.940-01	2.886+01	0.000	1.970+00
1.533-03	1.975-02	3.123-05	9.999-01	2.899-01	1.320-05	6.858-01	6.941-01	2.886+01	0.000	2.002+00

DISTANCE FROM WALL,FT

0.000	4.641-05	1.585-04	2.995-04	4.597-04	8.077-04	1.533-03

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

N	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01
	-1.108-05	2.023-07	-4.272-07	9.964-08	2.435-08	7.097-09	0.000
	2.053-05	-1.146-06	9.588-07	-1.370-07	-1.569-08	9.389-09	-1.585-08

O	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01
	1.108-05	-2.023-07	4.272-07	-9.964-08	-2.435-08	-7.097-09	-0.000
	-2.053-05	1.146-06	-9.588-07	1.370-07	1.569-08	-9.389-09	1.585-08

MOLE FRACTIONS

N	1.000-30	2.954-31	2.408-22	1.951-18	1.367-16	2.547-15	5.535-15
O	1.000-30	1.221-15	6.480-11	7.679-09	7.326-08	3.461-07	5.227-07
NO	1.500-16	7.209-07	3.567-05	1.966-04	4.397-04	7.646-04	8.855-04
N2	7.881-01	7.881-01	7.880-01	7.880-01	7.878-01	7.877-01	7.876-01
O2	2.119-01	2.119-01	2.119-01	2.118-01	2.117-01	2.116-01	2.115-01

CASE 1 - - - - - - - - - - - - STREAMWISE DIMENSION .50000-00 FEET - - - -24 OCT 69 15:31:58

ITERATED VALUES CAMP MAX.LIN MAX.ERRORS IN CONSERVATION EQS.

ITS	TIME	ALPH	FPP.		ERROR	MOMENTUM		ENERGY		N	
1	.675	1.099	.2904	.4999	1.-07	9	1.3-04	6	1.3-01	2	-7.0-05 0

ALPHA	XI (LB /SEC)**2	RCKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC	RERAD SQ FT)	QCOND
1.099+00	1.481-04	1.000+00	1.278-01	4.803+03	0.000	1.721-02	9.238+00	9.238+00	0.000	9.238+00

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR NITROGEN	OXYGEN
1.276+00	0.000	0.000	0.000	0.000	-1.237-06	1.237-06

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR NITROGEN	OXYGEN
8.548-03	9.947-03	0.000	0.000	0.000	1.768-01	1.770-01

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR NITROGEN	OXYGEN
9.013-04	9.922-04	9.922-04	1.049-03	3.038+05	-2.999-02	-3.002-02

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	0.000	0.000	2.904-01	1.276+00	7.125+01	2.156+02	1.794+02	7.125+01	5.300+02	4.330+10
2.542-04	5.495-01	4.907-02	1.581-01	3.944-01	1.268+00	2.168+02	3.142+02	8.408+01	2.005+02	1.326+03	2.738+10
8.683-04	1.099+00	2.130-01	4.102-01	4.139-01	1.199+00	4.021+02	3.634+02	-1.320+01	3.246+02	1.801+03	2.349+10
1.641-03	1.648+00	4.986-01	6.254-01	3.693-01	1.009+00	5.982+02	3.531+02	-1.358+02	4.179+02	2.137+03	2.156+10
2.518-03	2.198+00	8.928-01	8.000-01	2.663-01	7.049-01	7.717+02	2.785+02	-1.896+02	4.768+02	2.343+03	2.059+10
4.424-03	3.297+00	1.890+00	9.752-01	5.256-02	1.359-01	9.633+02	7.020+01	-8.219+01	5.251+02	2.509+03	1.990+10
8.398-03	5.495+00	4.082+00	1.000+00	0.000	0.000	1.000+03	0.000	1.831+01	5.392+02	2.558+03	1.971+10

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	9.529-03	1.107-05	1.710+00	-4.292-02	-6.916-07	6.870-01	6.940-01	2.886+01	0.000	0.000
2.542-04	3.810-03	2.025-05	1.251+00	2.455-01	7.253-06	6.854-01	6.940-01	2.886+01	0.000	5.072-01
8.683-04	2.803-03	2.479-05	1.127+00	2.722-01	9.843-06	6.855-01	6.940-01	2.886+01	0.000	9.668-01
1.641-03	2.363-03	2.775-05	1.063+00	2.820-01	1.141-05	6.856-01	6.940-01	2.886+01	0.000	1.362+00
2.518-03	2.155-03	2.948-05	1.030+00	2.863-01	1.231-05	6.857-01	6.940-01	2.886+01	0.000	1.669+00
4.424-03	2.012-03	3.084-05	1.006+00	2.891-01	1.301-05	6.858-01	6.940-01	2.886+01	0.000	1.970+00
8.398-03	1.975-03	3.123-05	9.999-01	2.899-01	1.320-05	6.858-01	6.941-01	2.886+01	0.000	2.002+00

DISTANCE FROM WALL,FT

	0.000	2.542-04	8.683-04	1.641-03	2.518-03	4.424-03	8.398-03

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

N	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01
	-2.653-05	1.931-07	3.915-07	-1.498-08	-3.952-08	4.092-08	0.000
	4.863-05	3.611-07	-7.398-07	-4.466-08	7.319-08	-7.208-08	3.485-08

O	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01
	2.653-05	-1.931-07	-3.915-07	1.498-08	3.952-08	-4.092-08	-0.000
	-4.863-05	-3.611-07	7.398-07	4.466-08	-7.319-08	7.208-08	-3.485-08

MOLE FRACTIONS

N	1.000-39	9.332-31	7.629-22	6.199-18	4.353-16	8.130-15	1.767-14
O	1.000-39	3.858-15	2.051-10	2.434-08	2.325-07	1.100-06	1.662-06
NO	1.500-16	7.208-07	3.568-05	1.965-04	4.402-04	7.660-04	8.871-04
N2	7.881-01	7.881-01	7.880-01	7.880-01	7.878-01	7.877-01	7.876-01
O2	2.119-01	2.119-01	2.119-01	2.118-01	2.117-01	2.116-01	2.115-01

CASE 2 - - - - - - - - - - - - STREAMWISE DIMENSION .50000-00 FEET - - - -24 OCT 69 15:31:59

ITERATED VALUES

ITS	TIME	ALPH	FPPW	DAMP	MAX.LIN ERROR		MAX.ERRORS IN CONSERVATION EQS. MOMENTUM		ENERGY		N	
1	.644	1.099	.2904	.4999	6.-08	6	6.8-06	3	7.8-03	2	-1.5-05	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC SQ FT)	RERAD	QCOND
1.099+00	1.482-03	1.000+00	1.278+00	4.804+03	0.000	5.444-02	2.921+01	2.921+01	0.000	2.921+01

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR NITROGEN	OXYGEN
4.036+00	0.000	0.000	0.000	0.000	-7.995-07	7.995-07

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR NITROGEN	OXYGEN
2.703-02	3.146-02	0.000	0.000	0.000	2.604-01	2.604-01

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR NITROGEN	OXYGEN
2.848-04	3.138-04	3.138-04	3.314-04	3.039+06	6.826-04	6.826-04

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	0.000	0.000	2.904-01	4.036+00	7.125+01	2.156+02	1.794+02	7.125+01	5.300+02	4.330+11
8.038-05	5.495-01	4.908-02	1.881-01	3.944-01	4.010+00	2.168+02	3.142+02	8.406+01	[illegible]2	1.326+03	2.738+11
2.746-04	1.099+00	2.130-01	4.102-01	4.139-01	3.791+00	4.022+02	3.604+02	-1.324+01	[illegible]	1.801+03	2.349+11
5.188-04	1.649+00	4.987-01	6.254-01	3.692-01	3.190+00	5.982+02	3.531+02	-1.358+02	4.17[illegible]2	2.137+03	2.156+11
7.962-04	2.198+00	8.929-01	8.000-01	2.662-01	2.229+00	7.717+02	2.785+02	-1.895+02	4.767+02	2.343+03	2.060+11
1.399-03	3.297+00	1.890+00	9.752-01	5.256-02	4.300-01	9.633+02	7.019+01	-8.217+01	5.249+02	2.509+03	1.990+11
2.655-03	5.495+00	4.082+00	1.000+00	0.000	0.000	1.000+03	0.000	1.831+01	5.390+02	2.557+03	1.971+11

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	9.529-02	1.107-05	1.710+00	-4.292-02	-6.915-07	6.870-01	6.940-01	2.886+01	0.000	0.000
8.038-05	3.810-02	2.025-05	1.251+00	2.455-01	7.254-06	6.854-01	6.940-01	2.886+01	0.000	5.073-01
2.746-04	2.803-02	2.479-05	1.127+00	2.722-01	9.842-06	6.855-01	6.940-01	2.886+01	0.000	9.670-01
5.188-04	2.363-02	2.774-05	1.063+00	2.820-01	1.141-05	6.856-01	6.940-01	2.886+01	0.000	1.362+00
7.962-04	2.156-02	2.948-05	1.030+00	2.863-01	1.231-05	6.857-01	6.940-01	2.886+01	0.000	1.669+00
1.399-03	2.013-02	3.084-05	1.006+00	2.891-01	1.300-05	6.858-01	6.940-01	2.886+01	0.000	1.970+00
2.655-03	1.975-02	3.123-05	9.999-01	2.899-01	1.320-05	6.858-01	6.941-01	2.886+01	0.000	2.002+00

DISTANCE FROM WALL,FT

	0.000	8.038-05	2.746-04	5.188-04	7.962-04	1.399-03	2.655-03

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

N	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01
	-8.476-06	-3.613-07	-4.652-07	-2.886-07	-1.249-07	-3.323-08	0.000
	1.477-05	-1.891-07	3.214-07	2.978-07	8.344-08	6.365-08	-3.342-08

O	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01
	8.476-04	3.613-07	4.652-07	2.886-07	1.249-07	3.323-08	-0.000
	-1.477-05	1.891-07	-3.214-07	-2.978-07	-8.344-08	-6.365-08	3.342-08

MOLE FRACTIONS

N	1.000-39	2.952-31	2.407-22	1.951-18	1.347-16	2.547-15	5.535-15
O	1.000-39	1.220-15	6.479-11	7.678-09	7.326-08	3.461-07	5.227-07
NO	1.500-15	7.208-07	3.566-05	1.966-04	4.397-04	7.646-04	8.855-04
N2	7.881-01	7.881-01	7.880-01	7.880-01	7.878-01	7.877-01	7.876-01
O2	2.119-01	2.119-01	2.119-01	2.118-01	2.117-01	2.116-01	2.115-01

CASE 1 - - - - - - - - - - - - STREAMWISE DIMENSION .10000+01 FEET - - - -24 OCT 69 15:32:00

ITERATED VALUES

ITS	TIME	ALPH	FPP	DAMP	MAX.LIN ERROR		MAX.ERRORS IN CONSERVATION EQS. MOMENTUM		ENERGY		N	
1	.663	1.099	.2904	.4999	6.-03	9	9.6-05	6	9.5-02	2	-6.7-05	0

ALPHA	XI (LB /SEC)**2	ROKAF (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL (BTU/SEC SQ FT)	TOT ENTH	RERAD	QCOND
1.099+00	2.963-04	1.000+00	1.278-01	4.603+03	0.000	1.217-02	6.532+00	6.532+00	0.000	6.532+00

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR NITROGEN	OXYGEN
9.024-01	0.000	0.000	0.000	0.000	-7.827-07	7.827-07

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR NITROGEN	OXYGEN
6.044-03	7.034-03	0.000	0.000	0.000	1.121-01	1.122-01

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR NITROGEN	OXYGEN
1.274-03	1.403-03	1.403-03	1.483-03	3.038+05	-2.528-02	-2.532-02

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	0.000	0.000	2.904-01	9.024-01	7.125+01	2.156+02	1.794+02	7.125+01	5.300+02	4.330+10
3.595-04	5.495-01	4.907-02	1.481-01	3.944-01	8.965-01	2.168+02	3.142+02	8.407+01	2.005+02	1.326+03	2.738+10
1.228-03	1.099+00	2.130-01	4.102-01	4.139-01	8.475-01	4.021+02	3.604+02	-1.322+01	3.246+02	1.802+03	2.349+10
2.320-03	1.648+00	4.986-01	6.254-01	3.693-01	7.133-01	5.982+02	3.531+02	-1.358+02	4.180+02	2.137+03	2.156+10
3.561-03	2.198+00	8.929-01	8.000-01	2.663-01	4.984-01	7.717+02	2.785+02	-1.895+02	4.768+02	2.343+03	2.059+10
6.257-03	3.297+00	1.890+00	9.752-01	5.256-02	9.612-02	9.633+02	7.020+01	-8.218+01	5.251+02	2.509+03	1.990+10
1.188-02	5.495+00	4.082+00	1.000+00	0.000	0.000	1.000+03	0.000	1.831+01	5.392+02	2.558+03	1.971+10

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	9.529-03	1.107-05	1.710+00	-4.292-02	-6.916-07	6.870-01	6.940-01	2.886+01	0.000	0.000
3.595-04	3.810-03	2.025-05	1.251+00	2.455-01	7.254-06	6.854-01	6.940-01	2.886+01	0.000	5.072-01
1.228-03	2.803-03	2.479-05	1.127+00	2.722-01	9.843-06	6.855-01	6.940-01	2.886+01	0.000	9.668-01
2.320-03	2.363-03	2.775-05	1.063+00	2.820-01	1.141-05	6.856-01	6.940-01	2.886+01	0.000	1.362+00
3.561-03	2.155-03	2.948-05	1.030+00	2.863-01	1.231-05	6.857-01	6.940-01	2.886+01	0.000	1.669+00
6.257-03	2.012-03	3.084-05	1.006+00	2.891-01	1.301-05	6.858-01	6.940-01	2.886+01	0.000	1.970+00
1.188-02	1.975-03	3.123-05	9.999-01	2.899-01	1.320-05	6.858-01	6.941-01	2.886+01	0.000	2.002+00

DISTANCE FROM WALL,FT

0.000	3.595-04	1.228-03	2.320-03	3.561-03	6.257-03	1.188-02

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

N	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01
	-1.495-05	-2.446-06	-1.075-06	-9.827-07	-4.594-07	3.333-08	0.000
	2.276-05	2.495-06	1.682-07	9.523-07	4.484-07	-9.609-08	6.576-08

O	2.350-01	2,350-01	2.350-01	2.350-01	2.350-01	2.350-01	2,350-01
	1.495-05	2,446-06	1.075-06	9.827-07	4.594-07	-3.333-08	-0.000
	-2.276-05	-2,495-06	-1.682-07	-9.523-07	-4.484-07	9.609-08	-6.576-08

MOLE FRACTIONS

N	1.000-30	9,340-31	7.633-22	6.200-18	4.353-16	8.130-15	1.767-14
O	1.000-30	3,860-15	2.052-10	2.435-08	2.325-07	1.100-06	1.662-06
NO	1.500-16	7,209-07	3.568-05	1.968-04	4.402-04	7.660-04	8.871-04
N2	7.881-01	7,881-01	7.880-01	7.880-01	7.878-01	7.877-01	7.876-01
O2	2.119-01	2,119-01	2.119-01	2.118-01	2.117-01	2.116-01	2.115-01

CASE 2 - - - - - - - - - - - - STREAMWISE DIMENSION .10000+01 FEET - - - -24 OCT 69 15:32:01

ITERATED VALUES

ITS	TIME	ALPH	EPE.	DAMP	MAX.LIN ERROR		MAX.ERRORS IN CONSERVATION EQS. MOMENTUM		ENERGY	
1	.657	1.099	.2914	.4999	1.-08	6	3.2-06	2	-8.1-03	2	8.1-05	0

ALPHA	XI (LB /SEC)**2	DCKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC SQ FT)	RERAD	QCOND
1.099+00	2.963-03	1.000+00	1.278+00	4.804+03	0.000	3.849-02	2.066+01	2.066+01	0.000	2.066+01

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR NITROGEN	OXYGEN
2.854+00	0.000	0.000	0.000	0.000	3.110-06	-3.110-06

MOM TRANS COEFF. RHOE*UE*CF/2	HEAT TRANS COEFF. RHOE*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR NITROGEN	OXYGEN
1.911-02	2.224-02	0.000	0.000	0.000	-4.246-01	-4.250-01

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR NITROGEN	OXYGEN
4.028-04	4.436-04	4.438-04	4.687-04	3.039+06	2.662-04	2.665-04

NODAL INFORMATION

DISTANCE FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	0.000	0.000	2.904-01	2.854+00	7.125+01	2.156+02	1.794+02	7.125+01	5.300+02	4.330+11
1.137-04	5.495-01	4.908-02	1.881-01	3.944-01	2.836+00	2.168+02	3.142+02	8.406+01	2.005+02	1.326+03	2.738+11
3.883-04	1.099+00	2.130-01	4.102-01	4.139-01	2.681+00	4.022+02	3.604+02	-1.324+01	3.246+02	1.801+03	2.349+11
7.337-04	1.649+00	4.987-01	6.254-01	3.692-01	2.256+00	5.982+02	3.531+02	-1.358+02	4.179+02	2.137+03	2.156+11
1.126-03	2.198+00	8.929-01	8.000-01	2.662-01	1.576+00	7.717+02	2.785+02	-1.895+02	4.767+02	2.343+03	2.060+11
1.978-03	3.297+00	1.890+00	9.752-01	5.256-02	3.041-01	9.633+02	7.019+01	-8.217+01	5.249+02	2.509+03	1.990+11
3.755-03	5.495+00	4.082+00	1.000+00	0.000	0.000	1.000+03	0.000	1.831+01	5.390+02	2.557+03	1.971+11

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	9.529-02	1.107-05	1.710+00	-4.292-02	-6.915-07	6.870-01	6.940-01	2.886+01	0.000	0.000
1.137-04	3.810-02	2.025-05	1.251+00	2.455-01	7.254-06	6.854-01	6.940-01	2.886+01	0.000	5.073-01
3.883-04	2.803-02	2.479-05	1.127+00	2.722-01	9.842-06	6.855-01	6.940-01	2.886+01	0.000	9.670-01
7.337-04	2.363-02	2.774-05	1.063+00	2.820-01	1.141-05	6.856-01	6.940-01	2.886+01	0.000	1.362+00
1.126-03	2.156-02	2.948-05	1.030+00	2.863-01	1.231-05	6.857-01	6.940-01	2.886+01	0.000	1.669+00
1.978-03	2.013-02	3.084-05	1.006+00	2.891-01	1.300-05	6.858-01	6.940-01	2.886+01	0.000	1.970+00
3.755-03	1.975-02	3.123-05	9.999-01	2.899-01	1.320-05	6.858-01	6.941-01	2.886+01	0.000	2.002+00

DISTANCE FROM WALL,FT

	0.000	1.137-04	3.883-04	7.337-04	1.126-03	1.978-03	3.755-03

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

N	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01	7.650-01
	[illegible]	-3.791-07	-1.967-07	-1.354-07	-1.013-07	-4.424-08	0.000
	[illegible]	3.320-07	1.115-07	6.215-08	5.187-08	8.273-08	-4.248-08

O	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01	2.350-01
	2.4[illegible]-05	3.791-07	1.967-07	1.354-07	1.013-07	4.424-08	-0.000
	-4.456-05	-3.320-07	-1.115-07	-6.215-08	-5.187-08	-8.273-08	4.248-08

MOLE FRACTIONS

N	1.000-30	2.952-31	2.407-22	1.951-18	1.367-16	2.547-15	5.535-15
O	1.000-30	1.220-15	6.480-11	7.678-[illegible]	7.326-08	3.461-07	5.227-07
NO	1.500-16	7.208-07	3.566-05	1.966-04	4.397-04	7.646-04	8.855-04
N2	7.881-01	7.881-01	7.880-01	7.880-01	7.878-01	7.877-01	7.876-01
O2	2.119-01	2.119-01	2.119-01	2.118-01	2.117-01	2.116-01	2.115-01

2. SAMPLE CASE 2 - ABLATING PHENOLIC CARBON FLAT PLATE

The second sample case is the solution of the boundary layer flow of air over an ablating phenolic carbon plate. This problem utilizes the multicomponent, general chemistry features of the program to greater advantage. A complete set of species thermochemical data is read in for all important species in the C-H-O-N-e^- system. Wall fluxes of the ablating material are prescribed, as is the wall temperature, thereby overriding any calculations of chemical equilibrium at the surface. Equal diffusion of all species is assumed and thermal diffusion is ignored for this problem. Solutions at six stations along the plate were requested, and a total of 13 nodes through the boundary layer were specified. Stagnation conditions for this problem were P_o = 43.4 atmospheres and H_o = 2100 Btu/lb. No radiation flux was specified.

The chemical composition data for this problem is of particular interest. It has been assumed that the phenolic carbon plate is in the steady-state ablation mode. It is apparent then, that the total elemental makeup of the ablation products as they are injected into the boundary layer must be the same as that of the virgin material. For phenolic carbon, it has been assumed that 0.326 pounds of resin are used per pound of virgin material and that the resin can be essentially represented by the molecule C_6H_6O (reference 8). Thus, every pound of virgin material consists of 0.9236 pounts of C, 0.0209 pounds of H, and 0.0554 pounds of O. This elemental composition is identical to that of the total ablation products for steady state ablation. The easiest way to input this ablation products chemical composition with the BLIMP code is to assign this chemical makeup to the "char" and delete any pyrolysis gas injection. This is the technique which has been used for this sample problem as can be seen below.

a. Input Cards for Sample Case Number 2

```
10204320210202      GRAPHITE PHENOLIC FLAT PLATE TEST CASE

 4
 1
-1.
 6
.03125     .36458     .69792     1.1562     1.6979     2.3646
13
0.         .024       .04        .072       .120       .20        .32        .48
.80        1.4        2.0        3.2        5.0
11  .95
43.4
2100.

 0.44      11.823     .019       .75        .75        250.
1000.
  5  .431  23.4       32.        3.467      106.7
  1HYDROGEN      1.00797                    -.0209
  6 CARBON       12.011                     -.9236
  7NITROGEN      14.008     -.765
  8 OXYGEN       16.0       -.235           -.0554
 99 ELECTRON     0.00055
  3  6  0  0  0  0  0  0  0  0  0  0  0  0JANAF 12/60                     C3
 189670+6 366220+5 146441+2 622536-4-168227+7 798410+2  500. 3000.1   0.C3
 189670+6 366220+5 144782+2 792232-4-646877+6 798410+2 3000. 5000.1   0.C3
  1  6  0  0  0  0  0  0  0  0  0  0  0  0JANAF 03/61                     C*
 000000-0 144120+5 586075+1 953976-4-766621+6 121290+2  500. 3000.2 100.C*
 000000-0 144120+5 485134+1 291605-3 307202+7 121290+2 3000. 5000.2 100.C*
  1  6  1  8  0  0  0  0  0  0  0  0  0  0JANAF 03/61                     CO
-264170+5 223570+5 865040+1 117021-3-898211+6 653700+2  500. 3000.1   0.CO
-264170+5 223570+5 115496+2-424139-3-131563+8 653700+2 3000. 5000.1   0.CO
  1  1  0  0  0  0  0  0  0  0  0  0  0  0JANAF 12/60                     H
 521020+5 134230+5 480223+1 555469-4 173095+6 388620+2  500. 3000.1   0.H
 521020+5 134230+5 308752+1 315025-3 929744+7 388620+2 3000. 5000.1   0.H
  2  7  0  0  0  0  0  0  0  0  0  0  0  0JANAF 03/61                     N2
 000000-0 221650+5 862699+1 116090-3-103715+7 637650+2  500. 3000.1   0.N2
 000000-0 221650+5 984175+1-116232-3-612728+7 637650+2 3000. 5000.1   0.N2
  2  8  0  0  0  0  0  0  0  0  0  0  0  0JANAF 03/61                     O2
 000000-0 234460+5 804370+1 510872-3-152718+6 679730+2  500. 3000.1   0.O2
 000000-0 234460+5 103071+2 290991-4-783079+7 679730+2 3000. 5000.1   0.O2
  1  6  0  0  0  0  0  0  0  0  0  0  0  0JANAF 03/61                     C
 170886+6 135500+5 444433+1 228125-3 409830+6 492870+2  500. 3000.1   0.C
 170886+6 135500+5 412212+1 261908-3 262886+7 492870+2 3000. 5000.1   0.C
  1  1  1  6  0  0  0  0  0  0  0  0  0  0JANAF 03/61                     CH
 142006+6 221300+5 826079+1 302211-3-100184+7 616120+2  500. 3000.1   0.CH
 142006+6 221300+5 707091+1 463281-3 552860+7 616120+2 3000. 5000.1   0.CH
  1  1  1  6  1  7  0  0  0  0  0  0  0  0JANAF 03/61                     CHN
 312000+5 355930+5 137023+2 552243-3-228955+7 758620+2  500. 3000.1   0.CHN
 312000+5 355930+5 178895+2-295052-3-183671+8 758620+2 3000. 5000.1   0.CHN
  1  1  1  6  1  8  0  0  0  0  0  0  0  0JANAF 03/61                     CHO
-290000+4 323670+5 128033+2 300638-3-201721+7 789830+2  500. 3000.1   0.CHO
```

```
-290000+4 323670+5 103028+2 633312-3 121615+8 789830+2 3000. 5000.1    0.CHO
 2  1  1  6  0  0  0  0  0  0  0  0  0  0JANAF 12/62                    CH2
 950000+5 329960+5 132894+2 413822-3-290273+7 684940+2  500. 3000.1    0.CH2
 950000+5 329960+5 140728+2 132150-3-239493+7 684940+2 3000. 5000.1    0.CH2
 3  1  1  6  0  0  0  0  0  0  0  0  0  0JANAF 12/62                    CH3
 319400+5 434190+5 182763+2 401025-3-461203+7 786040+2  500. 3000.1    0.CH3
 319400+5 434190+5 204899+2-108028-3-114692+8 786040+2 3000. 5000.1    0.CH3
 4  1  1  6  0  0  0  0  0  0  0  0  0  0JANAF 03/61                    CH4
-178950+5 530790+5 230948+2 677896-3-755061+7 825970+2  500. 3000.1    0.CH4
-178950+5 530790+5 236053+2 374323-3-368234+7 825970+2 3000. 5000.1    0.CH4
 1  6  1  7  0  0  0  0  0  0  0  0  0  0JANAF 12/62                    CN
 109000+6 232490+5 655906+1 115326-2 479517+6 669760+2  500. 3000.1    0.CN
 109000+6 232490+5 988013+1 313855-3-649453+7 669760+2 3000. 5000.1    0.CN
 1  6  2  8  0  0  0  0  0  0  0  0  0  0JANAF 03/61                    CO2
-940540+5 365350+5 144559+2 210386-3-182392+7 798480+2  500. 3000.1    0.CO2
-940540+5 365350+5 156451+2-381561-4-602768+7 798480+2 3000. 5000.1    0.CO2
 2  6  0  0  0  0  0  0  0  0  0  0  0  0JANAF 9/61                     C2
 198999+6 246990+5 776612+1 696081-3 185649+6 685519+2  500. 3000.1    0.C2
 198999+6 246990+5 104162+2 566841-4-640205+7 685519+2 3000. 5000.1    0.C2
 1  1  2  6  0  0  0  0  0  0  0  0  0  0DUFF BAUER 6/61                C2H
 117395+6 349620+5 134210+2 469100-3-187509+7 781140+2  500. 3000.1    0.C2H
 117395+6 349620+5 148516+2 109402-3-503862+7 781140+2 3000. 5000.1    0.C2H
 2  1  2  6  0  0  0  0  0  0  0  0  0  0JANAF 03/61                    C2H2
 541900+5 482570+5 189960+2 769044-3-409039+7 849690+2  500. 3000.1    0.C2H2
 541900+5 482570+5 203952+2 389062-3-645297+7 849690+2 3000. 5000.1    0.C2H2
 2  6  2  7  0  0  0  0  0  0  0  0  0  0JANAF 3/61                     C2N2
 738699+5 511070+5 188740+2 559856-3-896873+6 985479+2  500. 3000.1    0.C2N2
 738699+5 511070+5 208204+2 630229-5-346865+7 985479+2 3000. 5000.1    0.C2N2
 1  1  3  6  0  0  0  0  0  0  0  0  0  0DUFF BAUER 6/61                C3H
 127703+6 489620+5 194464+2 508379-3-311933+7 928820+2  500. 3000.1    0.C3H
 127703+6 489620+5 199582+2 245687-3-632514+6 928820+2 3000. 5000.1    0.C3H
 2  1  3  6  0  0  0  0  0  0  0  0  0  0DUFF BAUER 6/61                C3H2
 106522+6 635170+5 247444+2 992918-3-437596+7 104666+3  500. 3000.1    0.C3H2
 106522+6 635170+5 266623+2 364767-3-467730+7 104666+3 3000. 5000.1    0.C3H2
 3  1  3  6  0  0  0  0  0  0  0  0  0  0DUFF BAUER 6/61                C3H3
 764850+5 709520+5 286929+2 766031-3-548098+7 113604+3  500. 3000.1    0.C3H3
 764850+5 709520+5 291672+2 456238-3-138601+7 113604+3 3000. 5000.1    0.C3H3
 1  1  1  7  0  0  0  0  0  0  0  0  0  0JANAF 12/60                    HN
 792000+5 217660+5 823133+1 281555-3-126896+7 609290+2  500. 3000.1    0.HN
 792000+5 217660+5 765457+1 359853-3 180778+7 609290+2 3000. 5000.1    0.HN
 1  1  1  8  0  0  0  0  0  0  0  0  0  0JANAF 12/60                    HO
 933000+4 214040+5 773193+1 394386-3-973561+6 613820+2  500. 3000.1    0.HO
 933000+4 214040+5 965144+1-443528-4-686115+7 613820+2 3000. 5000.1    0.HO
 2  1  0  0  0  0  0  0  0  0  0  0  0  0JANAF 03/61                    H2
 000000-0 212100+5 711963+1 621950-3-712694+6 484650+2  500. 3000.1    0.H2
 000000-0 212100+5 681794+1 589854-3 265106+7 484650+2 3000. 5000.1    0.H2
 2  1  1  7  0  0  0  0  0  0  0  0  0  0JANAF 12/65                    H2N
 400999+5 305799+5 975862+1 114401-2-518970+6 701580+2  500. 3000.1    0.H2N
 400999+5 305799+5 137419+2 229493-4-610024+7 701580+2 3000. 5000.1    0.H2N
 2  1  1  8  0  0  0  0  0  0  0  0  0  0JANAF 03/61                    H2O
-577980+5 302010+5 112254+2 811397-3-260800+7 684210+2  500. 3000.1    0.H2O
-577980+5 302010+5 157278+2-191548-3-173599+8 684210+2 3000. 5000.1    0.H2O
 1  7  0  0  0  0  0  0  0  0  0  0  0  0JANAF 03/61                    N
```

```
 112965+6 134370+5 486944+1 383516-4 958460+5 480900+2  500. 3000.1    0.N
 112965+6 134370+5 428957+1 240844-3-417273+6 480900+2 3000. 5000.1    0.N
  1  7  1  8  0  0  0  0  0  0  0  0  0  0JANAF 06/63                   NO
 215800+5 227000+5 877623+1 899031-4-789656+6 688490+2  500. 3000.1    0.NO
 215800+5 227000+5 916260+1 657885-5-212519+7 688490+2 3000. 5000.1    0.NO
  1  8  0  0  0  0  0  0  0  0  0  0  0  0JANAF 06/62                   O
 595590+5 135220+5 497228+1 380768-5 154749+5 500960+2  500. 3000.1    0.O
 595590+5 135220+5 657489+1-224268-3-891782+7 500960+2 3000. 5000.1    0.O
  4  6  0  0  0  0  0  0  0  0  0  0  0  0JANAF 12/60                   C4
 242321+6 511230+5 205903+2 623436-4-257703+7 986760+2  500. 3000.1    0.C4
 242321+6 511230+5 210714+2-434895-4-404939+7 986760+2 3000. 5000.1    0.C4
  5  6  0  0  0  0  0  0  0  0  0  0  0  0JANAF 12/60                   C5
 242374+6 656230+5 264706+2 806528-4-337125+7 111641+3  500. 3000.1    0.C5
 242374+6 656230+5 271156+2-580271-4-543183+7 111641+3 3000. 5000.1    0.C5
  1 99  0  0  0  0  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61         E-
         +149010+5+498851+1-272800-5-135900+6+164558+22000. 10000.1     E-
         +149010+5+498851+1-272800-5-135900+6+164558+22000. 10000.1     E-
  1  6 -1 99  0  0  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61         C+
+428985+6+150120+5+489657+1+180700-4+340000+5+484232+22000. 10000.1     C+
+428985+6+150120+5+489657+1+180700-4+340000+5+484232+22000. 10000.1     C+
  1  7 -1 99  0  0  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61         N+
+446641+6+151310+5+501751+1+617100-4-184100+7+496847+22000. 10000.1     N+
+446641+6+151310+5+501751+1+617100-4-184100+7+496847+22000. 10000.1     N+
  2  7 -1 99  0  0  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61         N2+
+357258+6+251470+5+136508+2-327940-3-225630+8+656601+22000. 10000.1     N2+
+357258+6+251470+5+136508+2-327940-3-225630+8+656601+22000. 10000.1     N2+
  2  8  1 99  0  0  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61         O2-
-205250+5+267570+5+111480+2-656700-4-779100+7+699149+22000. 10000.1     O2-
-205250+5+267570+5+111480+2-656700-4-779100+7+699149+22000. 10000.1     O2-
  1  6  1  8 -1 99  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61         CO+
+294283+6+243830+5+893619+1+378000-4-150900+7+666595+22000. 10000.1     CO+
+294283+6+243830+5+893619+1+378000-4-150900+7+666595+22000. 10000.1     CO+
  1  7  1  8 -1 99  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61         NO+
+232919+6+241970+5+910216+1+277400-4-316600+7+654379+22000. 10000.1     NO+
+232919+6+241970+5+910216+1+277400-4-316600+7+654379+22000. 10000.1     NO+
  1  8 -1 99  0  0  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61         O+
+371999+6+149290+5+336271+1+306710-3+590200+7+484849+22000. 10000.1     O+
+371999+6+149290+5+336271+1+306710-3+590200+7+484849+22000. 10000.1     O+
  2  8 -1 99  0  0  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61         O2+
+279695+6+248730+5+594789+1+626340-3+103500+8+677731+22000. 10000.1     O2+
+279695+6+248730+5+594789+1+626340-3+103500+8+677731+22000. 10000.1     O2+
  1  8  1 99  0  0  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61         O-
+245000+5+149430+5+216633+1+805240-3+532500+7+492947+22000. 10000.1     O-
+245000+5+149430+5+216633+1+805240-3+532500+7+492947+22000. 10000.1     O-

.0966     .0841     .0724     .06089     .05135     .04188
```

(3 blank cards)

```
4760.     4760.     4760.     4760.     4760.     4760.
```

(3 blank cards)

.10392	.085338	.070857	.059069	.045895	.035085

b. Output from Sample Case Number 2

```
        BOUNDARY LAYER INTEGRAL MATRIX PROGRAM (BLIMP)

     AEROTHERM CORPORATION,PALO ALTO,CALIF (RMK,EPB)  24 OCT 69 15:32102

CASE GRAPHITE PHENOLIC FLAT PLATE TEST CASE

     CONTROL NUMBERS  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20

                      1  0  2  0  4  3  2  0  2  1  0  2  0  2 -0 -0 -0 -0 -0 -0

     PUNCH CONTROL
     IDENT  JSPEC
              -0

                                                    ETA VALUES
  U/UE TO       NODAL PT.
  NORM, ETA     AT WHICH
                ETA NORM.
  9.500-01         11         0.000     2.400-02  4.000-02  7.200-02  1.200-01  2.000-01  3.200-01  4.800-01  8.000-01
                              1.400+00  2.000+00  3.200+00  5.000+00

CASE                    1.00000+00

TOTAL ENTHALPY,BTU/LB   2.10000+03

TOTAL PRESSURE,ATM      4.34000+01

INCIDENT RAD FLUX,B/SF2 -0.00000

   MIXING LENGTH CONSTANT   =  4.4000-01
   SUBLAYER CONSTANT, YA+   =  1.1823+01
   CLAUSER NUMBER           =  1.9000-02
   TURBULENT SCHMIDT NUMBER=  7.5000-01
   TURBULENT PRANDTL NUMBER=  7.5000-01
   TRANSITION MOM,THICK,RE =  2.5000+02
```

CASE 1 - 24 OCT 69 15:32:02

RELATIVE ELEMENTAL COMPOSITIONS, ATOMIC WTS/UNIT MASS

AT.NO.	ELEMENT	ATOMIC WT	EDGE GAS	PYRO.GAS 1	CHAR 1	PYRO.GAS 2	CHAR 2	PYRO.GAS 3	CHAR 3
1	HYDROGEN	1.00797	.0000000	-.0000000	.0207368	-.0000000	-.0000000	-.0000000	-.0000000
6	CARBON	12.01100	.0000000	-.0000000	.0769039	-.0000000	-.0000000	-.0000000	-.0000000
7	NITROGEN	14.00800	.0546117	-.0000000	.0000000	-.0000000	-.0000000	-.0000000	-.0000000
8	OXYGEN	16.00000	.0146875	-.0000000	.0034628	-.0000000	-.0000000	-.0000000	-.0000000
99	ELECTRON	.00055	.0000000	-.0000000	.0000000	-.0000000	-.0000000	-.0000000	-.0000000

THERMODYNAMIC PROPERTY CURVE-FIT DATA (SEE MANUAL FOR FORMAT)

```
3.  6 0,  0 0.  0 0.  0 0,  0 0,  0 0.  OJANAF 12/60               C3
  .18967+06   .36622+05   .14644+02   .62254-04  -.16823+07   .79841+02  500.0000  3000.0000 1
  .18967+06   .36622+05   .14478+02   .79223-04  -.64688+06   .79841+02 3000.0000  5000.0000 1
1.  6 0,  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61               C*
  .00000      .14412+05   .58607+01   .95398-04  -.76662+06   .12129+02  500.0000  3000.0000 2
  .00000      .14412+05   .48513+01   .29161-03   .30720+07   .12129+02 3000.0000  5000.0000 2
1.  6 1,  8 0.  0 0.  0 0.  0 0,  0 0.  OJANAF 03/61               CO
 -.26417+05   .22357+05   .86504+01   .11702-03  -.89821+06   .65370+02  500.0000  3000.0000 1
 -.26417+05   .22357+05   .11550+02  -.42414-03  -.13156+08   .65370+02 3000.0000  5000.0000 1
1.  1 0,  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 12/60               H
  .52102+05   .13423+05   .48022+01   .55547-04   .17310+06   .38862+02  500.0000  3000.0000 1
  .52102+05   .13423+05   .30875+01   .31502-03   .92974+07   .38862+02 3000.0000  5000.0000 1
2.  7 0,  0 0.  0 0.  0 0,  0 0.  0 0.  OJANAF 03/61               N2
  .00000      .22165+05   .86270+01   .11609-03  -.10372+07   .63765+02  500.0000  3000.0000 1
  .00000      .22165+05   .98417+01  -.11623-03  -.61273+07   .63765+02 3000.0000  5000.0000 1
2.  8 0,  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61               O2
  .00000      .23446+05   .80437+01   .51087-03  -.15272+06   .67973+02  500.0000  3000.0000 1
  .00000      .23446+05   .10307+02   .29099-04  -.78308+07   .67973+02 3000.0000  5000.0000 1
1.  6 0,  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61               C
  .17089+06   .13550+05   .44443+01   .22812-03   .40983+06   .49287+02  500.0000  3000.0000 1
  .17089+06   .13550+05   .41221+01   .26191-03   .26289+07   .49287+02 3000.0000  5000.0000 1
1.  1 1,  6 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61               CH
  .14201+06   .22130+05   .82608+01   .30221-03  -.10018+07   .61612+02  500.0000  3000.0000 1
  .14201+06   .22130+05   .70709+01   .46328-03   .55286+07   .61612+02 3000.0000  5000.0000 1
1.  1 1,  6 1.  7 0.  0 0.  0 0.  0 0.  OJANAF 03/61               CHN
  .31200+05   .35593+05   .13702+02   .55224-03  -.22896+07   .75862+02  500.0000  3000.0000 1
  .31200+05   .35593+05   .17889+02  -.29505-03  -.18367+08   .75862+02 3000.0000  5000.0000 1
1.  1 1,  6 1.  8 0.  0 0.  0 0.  0 0.  OJANAF 03/61               CHO
 -.29000+04   .32367+05   .12803+02   .30064-03  -.20172+07   .78983+02  500.0000  3000.0000 1
 -.29000+04   .32367+05   .10303+02   .63331-03   .12162+08   .78983+02 3000.0000  5000.0000 1
2.  1 1,  6 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 12/62               CH2
  .95000+05   .32996+05   .13289+02   .41382-03  -.29027+07   .68494+02  500.0000  3000.0000 1
  .95000+05   .32996+05   .14073+02   .13215-03  -.23949+07   .68494+02 3000.0000  5000.0000 1
3.  1 1,  6 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 12/62               CH3
  .31940+05   .43419+05   .18276+02   .40102-03  -.46120+07   .78604+02  500.0000  3000.0000 1
  .31940+05   .43419+05   .20490+02  -.10803-03  -.11469+08   .78604+02 3000.0000  5000.0000 1
4.  1 1,  6 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61               CH4
 -.17895+05   .53079+05   .23095+02   .67790-03  -.75506+07   .82597+02  500.0000  3000.0000 1
 -.17895+05   .53079+05   .23605+02   .37432-03  -.36823+07   .82597+02 3000.0000  5000.0000 1
1.  6 1,  7 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 12/62               CN
  .10900+06   .23249+05   .65591+01   .11533-02   .47952+06   .66976+02  500.0000  3000.0000 1
  .10900+06   .23249+05   .98801+01   .31385-03  -.64945+07   .66976+02 3000.0000  5000.0000 1
1.  6 2,  8 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61               CO2
 -.94054+05   .36535+05   .14456+02   .21039-03  -.18239+07   .79848+02  500.0000  3000.0000 1
 -.94054+05   .36535+05   .15645+02  -.38156-04  -.60277+07   .79848+02 3000.0000  5000.0000 1
2.  6 0,  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 9/61                C2
```

```
   .19900+06   .24699+05   .77661+01   .69678-03   .13565+06   .68552+02  500.0000  3000.0000 1
   .19900+06   .24699+05   .10416+02   .56634-04  -.64020+07   .68552+02 3000.0000  5000.0000 1
1.  1 2.  6 0.  0 0.  0 0.  0 0.  0 0.  0DUFF BAUER 6/61                C2H
   .11740+06   .34962+05   .13421+02   .46910-03  -.18751+07   .78114+02  500.0000  3000.0000 1
   .11740+06   .34962+05   .14852+02   .10940-03  -.50386+07   .78114+02 3000.0000  5000.0000 1
2.  1 2.  6 0.  0 0.  0 0.  0 0.  0 0.  0JANAF 03/61                    C2H2
   .54190+05   .48257+05   .18396+02   .76904-03  -.40904+07   .84969+02  500.0000  3000.0000 1
   .54190+05   .48257+05   .20395+02   .38906-03  -.64530+07   .84969+02 3000.0000  5000.0000 1
2.  6 2.  7 0.  0 0.  0 0.  0 0.  0 0.  0JANAF 3/61                     C2N2
   .73870+05   .51107+05   .18874+02   .55946-03  -.89687+06   .98548+02  500.0000  3000.0000 1
   .73870+05   .51107+05   .20920+02   .63023-05  -.34686+07   .98548+02 3000.0000  5000.0000 1
1.  1 3.  6 0.  0 0.  0 0.  0 0.  0 0.  0DUFF BAUER 6/61                C3H
   .12770+06   .48962+05   .19446+02   .50338-03  -.31193+07   .92882+02  500.0000  3000.0000 1
   .12770+06   .48962+05   .19958+02   .24569-03  -.63251+06   .92882+02 3000.0000  5000.0000 1
2.  1 3.  6 0.  0 0.  0 0.  0 0.  0 0.  0DUFF BAUER 6/61                C3H2
   .10652+06   .63517+05   .24744+02   .99292-03  -.43760+07   .10467+03  500.0000  3000.0000 1
   .10652+06   .63517+05   .26662+02   .36477-03  -.46773+07   .10467+03 3000.0000  5000.0000 1
3.  1 3.  6 0.  0 0.  0 0.  0 0.  0 0.  0DUFF BAUER 6/61                C3H3
   .76485+05   .70952+05   .28693+02   .76603-03  -.54810+07   .11360+03  500.0000  3000.0000 1
   .76485+05   .70952+05   .29167+02   .45624-03  -.13860+07   .11360+03 3000.0000  5000.0000 1
1.  1 1.  7 0.  0 0.  0 0.  0 0.  0 0.  0JANAF 12/60                    HN
   .79200+05   .21766+05   .82313+01   .28155-03  -.12690+07   .60929+02  500.0000  3000.0000 1
   .79200+05   .21766+05   .76546+01   .35985-03   .18078+07   .60929+02 3000.0000  5000.0000 1
1.  1 1.  8 0.  0 0.  0 0.  0 0.  0 0.  0JANAF 12/60                    HO
   .93300+04   .21404+05   .77319+01   .39439-03  -.97356+06   .61382+02  500.0000  3000.0000 1
   .93300+04   .21404+05   .96514+01  -.44353-04  -.68611+07   .61382+02 3000.0000  5000.0000 1
2.  1 0.  0 0.  0 0.  0 0.  0 0.  0 0.  0JANAF 03/61                    H2
   .00000      .21210+05   .71196+01   .62195-03  -.71269+06   .48465+02  500.0000  3000.0000 1
   .00000      .21210+05   .68179+01   .58985-03   .26511+07   .48465+02 3000.0000  5000.0000 1
2.  1 1.  7 0.  0 0.  0 0.  0 0.  0 0.  0JANAF 12/65                    H2N
   .40100+05   .30580+05   .97586+01   .11440-02  -.51897+06   .70158+02  500.0000  3000.0000 1
   .40100+05   .30580+05   .13742+02   .22949-04  -.61002+07   .70158+02 3000.0000  5000.0000 1
2.  1 1.  8 0.  0 0.  0 0.  0 0.  0 0.  0JANAF 03/61                    H2O
  -.57798+05   .30201+05   .11225+02   .81140-03  -.26080+07   .68421+02  500.0000  3000.0000 1
  -.57798+05   .30201+05   .15728+02  -.19155-03  -.17360+08   .68421+02 3000.0000  5000.0000 1
1.  7 0.  0 0.  0 0.  0 0.  0 0.  0 0.  0JANAF 03/61                    N
   .11296+06   .13437+05   .48694+01   .38352-04   .95846+05   .48090+02  500.0000  3000.0000 1
   .11296+06   .13437+05   .42896+01   .24084-03  -.41727+06   .48090+02 3000.0000  5000.0000 1
1.  7 1.  8 0.  0 0.  0 0.  0 0.  0 0.  0JANAF 06/63                    NO
   .21580+05   .22700+05   .87762+01   .89903-04  -.78966+06   .68849+02  500.0000  3000.0000 1
   .21580+05   .22700+05   .91626+01   .65788-05  -.21252+07   .68849+02 3000.0000  5000.0000 1
1.  8 0.  0 0.  0 0.  0 0.  0 0.  0 0.  0JANAF 06/62                    O
   .59559+05   .13522+05   .49723+01   .38077-05   .15475+05   .50096+02  500.0000  3000.0000 1
   .59559+05   .13522+05   .65749+01  -.22427-03  -.89178+07   .50096+02 3000.0000  5000.0000 1
4.  6 0.  0 0.  0 0.  0 0.  0 0.  0 0.  0JANAF 12/60                    C4
   .24232+06   .51123+05   .20590+02   .62344-04  -.25770+07   .98676+02  500.0000  3000.0000 1
   .24232+06   .51123+05   .21071+02  -.43499-04  -.40494+07   .98676+02 3000.0000  5000.0000 1
5.  6 0.  0 0.  0 0.  0 0.  0 0.  0 0.  0JANAF 12/60                    C5
   .24237+06   .65623+05   .26471+02   .80653-04  -.33713+07   .11164+03  500.0000  3000.0000 1
   .24237+06   .65623+05   .27116+02  -.58027-04  -.54318+07   .11164+03 3000.0000  5000.0000 1
1. 99 0.  0 0.  0 0.  0 0.  0 0.  0 0.  0CONVAIR ZPH-122 12/61           E-
  -.00000      .14901+05   .49885+01  -.27280-05  -.13590+06   .16456+02 2000.0000 10000.0000 1
  -.00000      .14901+05   .49885+01  -.27280-05  -.13590+06   .16456+02 2000.0000 10000.0000 1
1.  6-1. 99 0.  0 0.  0 0.  0 0.  0 0.  0CONVAIR ZPH-122 12/61          C+
   .42899+06   .15012+05   .48966+01   .18070-04   .34000+05   .48423+02 2000.0000 10000.0000 1
   .42899+06   .15012+05   .48966+01   .18070-04   .34000+05   .48423+02 2000.0000 10000.0000 1
1.  7-1. 99 0.  0 0.  0 0.  0 0.  0 0.  0CONVAIR ZPH-122 12/61          N+
   .44664+06   .15131+05   .50175+01   .61710-04  -.18410+07   .49685+02 2000.0000 10000.0000 1
   .44664+06   .15131+05   .50175+01   .61710-04  -.18410+07   .49685+02 2000.0000 10000.0000 1
2.  7-1. 99 0.  0 0.  0 0.  0 0.  0 0.  0CONVAIR ZPH-122 12/61          N2+
```

```
 .35726+06   .25147+05   .13651+02  -.32794-03  -.22563+08   .65660+02 2000.0000 10000.0000 1
 .35726+06   .25147+05   .13651+02  -.32794-03  -.22563+08   .65660+02 2000.0000 10000.0000 1
2.  8 1. 99 0.  0 0.  0 0.  0 0.  0 0.  0CONVAIR ZPH-122 12/61        02-
-.20525+05   .26757+05   .11148+02  -.65670-04  -.77910+07   .69915+02 2000.0000 10000.0000 1
-.20525+05   .26757+05   .11148+02  -.65670-04  -.77910+07   .69915+02 2000.0000 10000.0000 1
1.  6 1.  8-1. 99 0.  0 0.  0 0.  0 0.  0CONVAIR ZPH-122 12/61        CO+
 .29428+06   .24383+05   .89362+01   .37800-04  -.15090+07   .66659+02 2000.0000 10000.0000 1
 .29428+06   .24383+05   .89362+01   .37800-04  -.15090+07   .66659+02 2000.0000 10000.0000 1
1.  7 1.  8-1. 99 0.  0 0.  0 0.  0 0.  0CONVAIR ZPH-122 12/61        NO+
 .23292+06   .24197+05   .91022+01   .27740-04  -.31660+07   .65438+02 2000.0000 10000.0000 1
 .23292+06   .24197+05   .91022+01   .27740-04  -.31660+07   .65438+02 2000.0000 10000.0000 1
1.  8-1. 99 0.  0 0.  0 0.  0 0.  0 0.  0CONVAIR ZPH-122 12/61        O+
 .37200+06   .14929+05   .33627+01   .30671-03   .59020+07   .48485+02 2000.0000 10000.0000 1
 .37200+06   .14929+05   .33627+01   .30671-03   .59020+07   .48485+02 2000.0000 10000.0000 1
2.  8-1. 99 0.  0 0.  0 0.  0 0.  0 0.  0CONVAIR ZPH-122 12/61        O2+
 .27970+06   .24873+05   .59479+01   .62634-03   .10350+08   .67773+02 2000.0000 10000.0000 1
 .27970+06   .24873+05   .59479+01   .62634-03   .10350+08   .67773+02 2000.0000 10000.0000 1
1.  8 1. 99 0.  0 0.  0 0.  0 0.  0 0.  0CONVAIR ZPH-122 12/61        O-
 .24500+05   .14943+05   .21663+01   .80524-03   .53250+07   .49295+02 2000.0000 10000.0000 1
 .24500+05   .14943+05   .21663+01   .80524-03   .53250+07   .49295+02 2000.0000 10000.0000 1


 ELEMENT  HYDROGEN     CARBON    NITROGEN    OXYGEN     ELECTRON
 BASE SP      H           C3        N2          CO          E-


MOLECULAR TRANSPORT PROPERTIES
  VISCOSITY ..... BUDDENBERG - WILKE MIXTURE FORMULA WITH MU(I) CALCULATED ON
                  THE BASIS OF D(I,I) = DBAR/G(I)**2

  THERMAL CONDUCTIVITY ..... MASON - SAXENA MIXTURE FORMULA WITH EUCKEN CORRECTION

  DIFFUSION COEFFICIENTS ..... D(I,J) = DBAR/(F(I)*F(J)) WITH DBAR BASED ON
                  SIGMA =   3.4670, EPOVRK =  106.7000, AND MREF =  32.0000


   METHODS EMPLOYED

    0 CONDENSED PHASE, VALUES FOR F(I) AND G(I) SET EQUAL TO 1.E+10

    1 VALUES FOR F(I) (OR G(I)) INPUT DIRECTLY

    2 VALUES FOR F(I) (OR G(I)) CALCULATED BY  F(I) =(M(I)/FITMOL)**FFA AND
      G(I) = (M(I)/FITGMW)**GGA WHERE M(I) IS SPECIES MOLECULAR WEIGHT,
      FITMOL =  23.4000, AND FFA =  .4310, FITGMW =  24.3000, AND GGA =  .4540

    3 VALUES FOR G(I) CALCULATED BY G(I) = SQRT(DBAR/D(I,I)) = (SIGMA(I)/SIGMA)
      * (EPS(I)/EPOVRK) **0.0795 * (M(I)/MREF) **0.25 WHERE SIGMA(I) AND EPS(I)
      ARE GIVEN WITH THERMODYNAMIC DATA

   SPECIES   F(I) METHOD G(I) METHOD         SPECIES   F(I) METHOD G(I) METHOD
   C3        1.204   2   1.196   2           CO        1.081   2   1.067   2
   H          .258   2    .236   2           N2        1.081   2   1.067   2
   E-         .010   2    .008   2           C*        *****   0   *****   0
   O2        1.144   2   1.133   2           C          .750   2    .726   2
   CH         .777   2    .753   2           CHN       1.064   2   1.049   2
   CHO       1.097   2   1.084   2           CH2        .802   2    .779   2
   CH3        .826   2    .804   2           CH4        .850   2    .828   2
```

C3	1.047	2	1.032	2	CO2	1.313	2	1.310	2
C2	1.011	2	.995	2	C2H	1.029	2	1.014	2
C2H2	1.047	2	1.032	2	C2N2	1.411	2	1.413	2
C3H	1.219	2	1.211	2	C3H2	1.233	2	1.226	2
C3H3	1.247	2	1.240	2	HN	.826	2	.804	2
HO	.872	2	.353	2	H2	.348	2	.323	2
H2N	.849	2	.828	2	H2O	.893	2	.873	2
N	.892	2	.779	2	NO	1.113	2	1.101	2
O	.849	2	.827	2	C4	1.363	2	1.363	2
C5	1.501	2	1.508	2	C+	.750	2	.726	2
N+	.802	2	.779	2	N2+	1.081	2	1.067	2
O2-	1.144	2	1.133	2	CO+	1.081	2	1.067	2
NO+	1.113	2	1.101	2	O+	.849	2	.827	2
O2+	1.144	2	1.133	2	O-	.849	2	.827	2

STAGNATION SOLUTION FOLLOWED BY BOUNDARY-LAYER EDGE EXPANSION

CP-FROZEN	CP-EQUIL	DLNM/DLNT	DLNM/DLNP	GAMMA
.31640-00	.55791-00	-.17878-00	.11182-01	.11968+01

TEMP = 3718.7415 DEG-K PRES = 43.4000 ATM MOL WT = 28.1757830
RELATIVE MASSES OF COMPONENTS 1,2 AND 3 .00000 .00000 .00000
ENTHALPY = .1166667+04 CAL/GM ENTROPY = .21376+01 CAL/GM-DEG K
DENSITY = .250136-00 LB/CUFT
VEL = .000 FT/SEC MACH = -.000 AREA = .000 SQFT/LB/SEC

SPECIES	MOLE FR.	SPECIES	MOLE FR.	SPECIES	MOLE FR.
C3	.00000	CO	.00000	H	.00000
N2	.72976-00	E-	.19070-06	C+	.00000
O2	.14369-00	C	.00000	CH	.00000
CHN	.00000	CHO	.00000	CH2	.00000
CH3	.00000	CH4	.00000	CN	.00000
CO2	.00000	C2	.00000	C2H	.00000
C2H2	.00000	C2N2	.00000	C3H	.00000
C3H2	.00000	C3H3	.00000	HN	.00000
HO	.00000	H2	.00000	H2N	.00000
H2O	.00000	N	.75863-04	NO	.79091-01
O	.47366-01	C4	.00000	C5	.00000
C+	.00000	N+	.22025-15	N2+	.86520-13
O2-	.58840-07	CO+	.00000	NO+	.29419-06
O+	.50390-12	O2+	.25906-09	O-	.44908-07

CP-FROZEN	CP-EQUIL	DLNM/DLNT	DLNM/DLNP	GAMMA
.30752-00	.37444-00	-.22265-01	.92588-03	.12370+01

TEMP = 2536.1093 DEG-K PRES = 4.1924 ATM MOL WT = 28.8067470
RELATIVE MASSES OF COMPONENTS 1,2 AND 3 .00000 .00000 .00000
ENTHALPY = .6600046+03 CAL/GM ENTROPY = .21376+01 CAL/GM-DEG K
DENSITY = .362243-01 LB/CUFT
VEL = .676+04 FT/SEC MACH = .216+01 AREA = .409-02 SQFT/LB/SEC

SPECIES	MOLE FR.	SPECIES	MOLE FR.	SPECIES	MOLE FR.
C3	.00000	CO	.00000	H	.00000
N2	.77426-00	E-	.27446-09	C+	.00000
O2	.19736-00	C	.00000	CH	.00000

CHN	.00000	CHO	.00000	CH2	.00000
CH3	.00000	CH4	.00000	CN	.00000
CO2	.00000	C2	.00000	C2H	.00000
C2H2	.00000	C2N2	.00000	C3H	.00000
C3H2	.00000	C3H3	.00000	HN	.00000
HO	.00000	H2	.00000	H2N	.00000
H2O	.00000	N	.17326-06	NO	.24655-01
O	.37167-02	C4	.00000	C5	.00000
C+	.00000	N+	.89252-24	N2+	.33622-19
O2-	.86527-10	CO+	.00000	NO+	.37160-09
O+	.27314-19	O2+	.19452-13	O-	.10634-10

CP-FROZEN	CP-EQUIL	DLNM/DLNT	DLNM/DLNP	GAMMA
.35684-00	.36567-00	-.17820-01	.72116-03	.12416+01

TEMP = 2470.1725 DEG-K PRES = 3.6499 ATM MOL WT = 28.8186390
RELATIVE MASSES OF COMPONENTS 1,2 AND 3 .00000 .00000 .00000
ENTHALPY = .6360861+03 CAL/GM ENTROPY = .21376+01 CAL/GM-DEG K
DENSITY = .323920-01 LB/CUFT
VEL = .691+04 FT/SEC MACH = .224+01 AREA = .446-02 SQFT/LB/SEC

SPECIES	MOLE FR.	SPECIES	MOLE FR.	SPECIES	MOLE FR.
C3	.00000	CO	.00000	H	.00000
N2	.77586-00	E-	.15314-09	C+	.00000
O2	.19913-00	C	.00000	CH	.00000
CHN	.00000	CHO	.00000	CH2	.00000
CH3	.00000	CH4	.00000	CN	.00000
CO2	.00000	C2	.00000	C2H	.00000
C2H2	.00000	C2N2	.00000	C3H	.00000
C3H2	.00000	C3H3	.00000	HN	.00000
HO	.00000	H2	.00000	H2N	.00000
H2O	.00000	N	.10107-06	NO	.22114-01
O	.28929-02	C4	.00000	C5	.00000
C+	.00000	N+	.16978-24	N2+	.96558-20
O2-	.49686-10	CO+	.00000	NO+	.20795-09
O+	.77715-19	O2+	.85236-14	O-	.51338-11

CP-FROZEN	CP-EQUIL	DLNM/DLNT	DLNM/DLNP	GAMMA
.30607-00	.35702-00	-.13773-01	.54099-03	.12467+01

TEMP = 2399.4878 DEG-K PRES = 3.1422 ATM MOL WT = 28.8290880
RELATIVE MASSES OF COMPONENTS 1,2 AND 3 .00000 .00000 .00000
ENTHALPY = .4109449+03 CAL/GM ENTROPY = .21376+01 CAL/GM-DEG K
DENSITY = .287175-01 LB/CUFT
VEL = .708+04 FT/SEC MACH = .232+01 AREA = .492-02 SQFT/LB/SEC

SPECIES	MOLE FR.	SPECIES	MOLE FR.	SPECIES	MOLE FR.
C3	.00000	CO	.00000	H	.00000
N2	.77744-00	E-	.78749-10	C+	.00000
O2	.20086-00	C	.00000	CH	.00000
CHN	.00000	CHO	.00000	CH2	.00000
CH3	.00000	CH4	.00000	CN	.00000
CO2	.00000	C2	.00000	C2H	.00000
C2H2	.00000	C2N2	.00000	C3H	.00000

C3H2	.00000	C3H3	.00000	HN	.00000
HO	.00000	H2	.00000	H2N	.00000
H2O	.00000	N	.54581-07	NO	.19531-01
O	.21688-02	C4	.00000	C5	.00000
C+	.00000	N+	.25776-25	N2+	.23458-20
O2-	.26498-1[illegible]	CO+	.00000	NO+	.10749-09
O+	.18[illegible]8-1[illegible]	O2+	.33378-14	O-	.22427-11

CP-FROZEN	CP-EQUIL	DLNM/DLNT	DLNM/DLNP	GAMMA
.30517-00	.34807-00	-.99958-02	.37915-03	.12524+01

TEMP = 2318.6930 DEG-K PRES = 2.6426 ATM MOL WT = 28.8384640
RELATIVE MASSES OF COMPONENTS 1,2 AND 3 .00000 .00000 .00000
ENTHALPY = .5828005+03 CAL/GM ENTROPY = .21376+01 CAL/GM-DEG K
DENSITY = .250018-01 LB/CUFT
VEL = .725+04 FT/SEC MACH = .242+01 AREA = .551-02 SQFT/LB/SEC

SPECIES	MOLE FR.	SPECIES	MOLE FR.	SPECIES	MOLE FR.
C3	.00000	CO	.00000	H	.00000
N2	.77907-00	E-	.34857-10	C+	.00000
O2	.20264-00	C	.00000	CH	.00000
CHN	.00000	CHO	.00000	CH2	.00000
CH3	.00000	CH4	.00000	CN	.00000
CO2	.00000	C2	.00000	C2H	.00000
C2H2	.00000	C2N2	.00000	C3H	.00000
C3H2	.00000	C3H3	.00000	HN	.00000
HO	.00000	H2	.00000	H2N	.00000
H2O	.00000	N	.25766-07	NO	.16771-01
O	.15190-02	C4	.00000	C5	.00000
C+	.00000	N+	.25806-26	N2+	.41812-21
O2-	.12323-1[illegible]	CO+	.00000	NO+	.47994-10
O+	.32422-2[illegible]	O2+	.10623-14	O-	.81490-12

CP-FROZEN	CP-EQUIL	DLNM/DLNT	DLNM/DLNP	GAMMA
.30424-00	.34033-00	-.71136-02	.26053-03	.12579+01

TEMP = 2240.2760 DEG-K PRES = 2.2286 ATM MOL WT = 28.8453270
RELATIVE MASSES OF COMPONENTS 1,2 AND 3 .00000 .00000 .00000
ENTHALPY = .5560429+03 CAL/GM ENTROPY = .21376+01 CAL/GM-DEG K
DENSITY = .218276-01 LB/CUFT
VEL = .742+04 FT/SEC MACH = .251+01 AREA = .618-02 SQFT/LB/SEC

SPECIES	MOLE FR.	SPECIES	MOLE FR.	SPECIES	MOLE FR.
C3	.00000	CO	.00000	H	.00000
N2	.78050-00	E-	.14862-10	C+	.00000
O2	.20416-00	C	.00000	CH	.00000
CHN	.00000	CHO	.00000	CH2	.00000
CH3	.00000	CH4	.00000	CN	.00000
CO2	.00000	C2	.00000	C2H	.00000
C2H2	.00000	C2N2	.00000	C3H	.00000
C3H2	.00000	C3H3	.00000	HN	.00000
HO	.00000	H2	.00000	H2N	.00000
H2O	.00000	N	.11731-07	NO	.14298-01
O	.10434-02	C4	.00000	C5	.00000

C+	.00000	N+	.23446-27	N2+	.69494-22
O2-	.55591-11	CO+	.00000	NO+	.20704-10
O+	.52372-21	O2+	.32224-15	O-	.28336-12

CP-FROZEN	CP-EQUIL	DLNM/DLNT	DLNM/DLNP	GAMMA
.30310-00	.33233-00	-.45801-02	.16074-03	.12642+01

TEMP = 2148.1273 DEG-K PRES = 1.8176 ATM MOL WT = 28.8510960
RELATIVE MASSES OF COMPONENTS 1,2 AND 3 .00000 .00000 .00000
ENTHALPY = .5252376+03 CAL/GM ENTROPY = .21376+01 CAL/GM-DEG K
DENSITY = .185697-01 LB/CUFT
VEL = .760+04 FT/SEC MACH = .262+01 AREA = .708-02 SQFT/LB/SEC

SPECIES	MOLE FR.	SPECIES	MOLE FR.	SPECIES	MOLE FR.
C3	.00000	CO	.00000	H	.00000
N2	.78197-00	E-	.50069-11	C*	.00000
O2	.20572-00	C	.00000	CH	.00000
CHN	.00000	CHO	.00000	CH2	.00000
CH3	.00000	CH4	.00000	CN	.00000
CO2	.00000	C2	.00000	C2H	.00000
C2H2	.00000	C2N2	.00000	C3H	.00000
C3H2	.00000	C3H3	.00000	HN	.00000
HO	.00000	H2	.00000	H2N	.00000
H2O	.00000	N	.42991-08	NO	.11665-01
O	.64356-03	C4	.00000	C5	.00000
C+	.00000	N+	.11107-28	N2+	.71195-23
O2-	.20251-11	CO+	.00000	NO+	.71058-11
O+	.51445-22	O2+	.70731-16	O-	.73815-13

DISTANCE,FT	.31250-01	.36458-00	.69792-00	.11562+01	.16979+01	.23646+01
ROKAP	.10000+01	.10000+01	.10000+01	.10000+01	.10000+01	.10000+01
XI,(LB/SEC)**2	.33751-03	.37575-02	.68137-02	.10509-01	.14326-01	.18378-01
PRESSURE RATIO	.96630-01	.84100-01	.72400-01	.60890-01	.51350-01	.41880-01
STATIC PRESSURE,ATM	.41924+01	.36499+01	.31422+01	.26426+01	.22286+01	.18176+01
EDGE VELOCITY,FT/SEC	.67568+04	.69144+04	.70764+04	.72533+04	.74177+04	.76025+04
BETA	.43155-02	.56333-01	.10042+00	.12864-00	.16129-00	.22731-00
INCIDENT RADIATION FLUX	.00000	.00000	.00000	.00000	.00000	.00000
ENTROPY DROP,BTU/LB R	.00000	.00000	.00000	.00000	.00000	.00000
*1/FLUX NORM,PARAMETER	-.24056+01	-.89235+01	-.13497+02	-.19210+02	-.25693+02	-.34306+02
*ALL TEMPERATURE,DEG R	.47630+04	.47600+04	.47600+04	.47600+04	.47600+04	.47600+04
COMP FLUX,LB/SEC FT**2	-.00000	-.00000	-.00000	-.00000	-.00000	-.00000
COMP FLUX,LB/SEC FT**2	-.00000	-.00000	-.00000	-.00000	-.00000	-.00000
COMP FLUX,LB/SEC FT**2	.10392+00	.85338-01	.70857-01	.59069-01	.45895-01	.35085-01

CASE 1 - - - - - - - - - - - - STREAMWISE DIMENSION .31250-01 FEET - - - -24 OCT 69 15:32:02

ITERATED VALUES				DAMP	MAX.LIN.		MAX.ERRORS IN CONSERVATION EQS.									
ITS	TIME	ALPH	FPPW		ERROR		MOMENTUM		ENERGY		C3		CO		H	
1	9,852	1.970	.5417	.1469	2.+00	16	-6.5-01	1	-2.2+03	1	3.4-01	1	-1.0-01	1	6.9-03	0
2	20,282	1.898	.5094	.1799	1.+00	16	-5.6-01	1	-9.4+02	1	2.8-01	1	-8.3-02	1	5.5-03	0
3	29,220	1.806	.5188	.2120	1.+00	16	-4.6-01	1	9.2+02	1	2.4-01	1	-7.0-02	1	4.6-03	0
4	38,715	1.723	.5470	.1848	1.+00	16	-3.6-01	1	1.7+03	1	2.7-01	1	-8.0-02	1	5.3-03	0
5	49,571	1.669	.4503	.1957	8.-01	16	-3.0-01	1	1.7+03	1	2.6-01	1	-7.6-02	1	5.0-03	0
6	59,167	1.633	.3814	.2468	6.-01	16	-2.4-01	1	1.4+03	1	2.0-01	1	-6.0-02	1	4.0-03	0
7	67,308	1.605	.3275	.3397	5.-01	16	-1.8-01	1	1.0+03	1	1.5-01	1	-4.4-02	1	2.9-03	0
8	74,795	1.584	.2874	.5785	3.-01	16	-1.2-01	1	5.8+02	1	8.6-02	1	-2.6-02	1	1.7-03	0
9	81,342	1.568	.2626	1,0000	1.-01	16	-5.2-02	1	2.7+02	1	4.0-02	1	-1.2-02	1	8.0-04	0
10	87,452	1.567	.2660	1,0000	2.-06	13	-1.7-02	11	-2.7+01	10	4.3-03	10	-1.3-03	10	8.6-05	0

PRIOR LAMINAR SOLUTION AFTER TRANSITION. TURBULENCE WILL BE INCLUDED AND SOLUTION CONTINUED

ITERATED VALUES

ITS	TIME	ALPH	FPP*	DAMP	MAX.LIN ERROR		MAX.ERRORS IN CONSERVATION EQS. MOMENTUM		ENERGY		C3		CO		H	
2	92,738	1.645	.3059	.0067	1.-07	12	-5.3+00	1	-7.2+03	9	1.8+00	9	-5.3-01	9	3.6-02	0
3	98,898	1.727	.3479	.0164	4.-07	12	-5.2+00	1	-3.9+03	9	1.8+00	9	-5.3-01	9	3.5-02	0
4	104,673	1.814	.3919	.0270	9.-07	12	-5.2+00	9	3.2+03	9	1.8+00	9	-5.3-01	9	3.5-02	0
5	110,649	1.904	.4372	.0385	1.-06	12	-5.1+00	9	3.2+03	9	1.7+00	9	-5.2-01	9	3.4-02	0
6	116,653	2.095	.5190	.1006	1.-06	12	-4.9+00	9	3.1+03	9	1.7+00	9	-5.0-01	9	3.3-02	0
7	123,342	2.304	.6013	.1546	1.-06	12	-4.5+00	9	2.8+03	9	1.5+00	9	-4.6-01	9	3.1-02	0
8	130,283	2.535	.6799	.2429	3.-06	12	-3.8+00	9	2.4+03	9	1.3+00	9	-4.0-01	9	2.6-02	0
9	138,385	2.798	.7603	.1306	4.-06	12	-4.4+00	9	2.6+03	9	1.4+00	9	-4.3-01	9	2.8-02	0
10	146,033	3.067	.8401	.2088	4.-06	12	-3.9+00	9	2.2+03	9	1.2+00	9	-3.7-01	9	2.5-02	0
11	155,664	3.373	.924	.3614	4.-06	12	-2.5+00	9	1.8+03	9	9.0-01	9	-2.7-01	9	1.8-02	0
12	165,486	3.711	1.0175	.5603	4.-06	12	-1.6+00	9	1.1+03	9	5.7-01	9	-1.7-01	9	1.1-02	0
13	174,847	3.858	1.0691	1,0000	2.-06	12	-6.4-01	9	5.4+02	9	2.5-01	9	-7.5-02	9	5.0-03	0
14	183,584	4.024	1.1339	1.0000	7.-07	7	-3.5-01	4	-2.2+02	5	-2.1-02	5	6.2-03	5	-4.1-04	0
15	189,894	4.126	1.1392	1.0000	5.-07	6	-1.6-01	4	-7.4+01	5	-9.7-03	5	2.9-03	5	-1.9-04	0
16	195,901	4.089	1.1398	1.0000	3.-07	7	5.0-02	6	-1.6+01	4	-2.7-03	4	8.1-04	4	-5.4-05	0
17	201,556	4.099	1.1396	1.0000	2.-07	9	1.5-02	6	6.2+00	6	-7.7-04	6	2.3-04	6	-1.5-05	0
18	206,953	4.096	1.1397	1.0000	2.-07	9	-4.2-03	6	-1.8+00	6	2.1-04	6	-6.2-05	6	4.2-06	0
19	212,145	4.097	1.1396	1.0000	1.-07	9	1.2-03	6	5.1-01	6	-6.2-05	12	-1.9-05	6	-1.2-06	0
20	217,289	4.096	1.1397	1.0000	2.-07	9	-3.5-04	6	-1.5-01	6	1.8-05	12	1.9-05	6	3.6-07	0
21	222,436	4.096	1.1397	1.0000	2.-07	9	1.0-04	6	4.1-02	6	-5.1-06	12	5.9-06	6	-1.1-07	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC SQ FT)	RERAD	QCOND
4.096+00	3.375-04	1.000+00	4.192+00	6.757+03	4.315-03	4.157-01	7.625+02	6.991+02	0.000	1.242+03

WALL SHEAR (LB/SQ FT)	MASS FLUXES MECH REM	PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
9.164+01	0.000	0.000	1.039-01	1.039-01	-1.834-03	-8.105-02	6.713-02	1.576-02

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
4.364-01	5.117-01	0.000	2.031-01	2.031-01	5.639-01	5.639-01	5.639-01	5.639-01

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
1.358-04	3.766-04	4.031-04	1.572-04	5.547+06	1.705-04	1.705-04	1.705-04	1.708-04

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	-2.500-01	0.000	1.140+00	9.164+01	6.099+02	1.236+03	2.045+03	6.099+02	4.760+03	4.740+11
1.209-05	9.831-02	-2.444-01	1.136-01	1.171+00	9.406+01	7.413+02	1.437+03	4.820+02	7.296+02	5.323+03	4.482+11
2.064-05	1.639-01	-2.345-01	1.886-01	1.117+00	9.560+01	8.365+02	1.469+03	-2.323+03	8.041+02	5.542+03	4.393+11
3.818-05	2.949-01	-2.010-01	3.158-01	8.237-01	9.798+01	1.009+03	1.164+03	-2.389+03	9.182+02	5.705+03	4.330+11
6.471-05	4.916-01	-1.253-01	4.428-01	4.682-01	9.977+01	1.192+03	6.947+02	-1.030+03	1.013+03	5.739+03	4.317+11
1.086-04	8.193-01	4.071-02	5.575-01	2.319-01	1.002+02	1.364+03	3.572+02	-3.412+02	1.081+03	5.703+03	4.331+11
1.736-04	1.311+00	3.382-01	6.439-01	1.196-01	9.875+01	1.499+03	1.895+02	-1.184+02	1.121+03	5.638+03	4.355+11

2.588-04	1.966+00	7.823-01	7.057-01	6.915-02	9.566+01	1.597+03	1.119+02	-2.048+01	1.143+03	5.569+03	4.382+11
4.261-04	3.277+00	1.762+00	7.545-01	5.107-02	8.682+01	1.726+03	8.502+01	-1.122+01	1.165+03	5.445+03	4.432+11
7.283-04	5.735+00	3.826+00	8.880-01	3.312-02	6.202+01	1.902+03	5.745+01	-1.080+01	1.183+03	5.186+03	4.541+11
1.016-03	8.193+00	6.093+00	9.500-01	1.734-02	3.565+01	2.010+03	3.090+01	-5.669+00	1.187+03	4.933+03	4.656+11
1.550-03	1.311+01	1.071+01	9.966-01	1.616-03	3.727+00	2.094+03	3.034+00	-9.329-01	1.188+03	4.630+03	4.806+11
2.343-03	2.048+01	1.828+01	1.000+00	0.000	0.000	2.100+03	0.000	1.099-01	1.188+03	4.566+03	4.840+11

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	3.284-02	4.483-05	9.211-01	3.275-01	2.202-05	6.667-01	7.396-01	2.723+01	0.000	0.000
1.209-05	3.001-02	4.836-05	9.081-01	3.293-01	2.342-05	6.800-01	7.393-01	2.783+01	1.216-02	2.262-01
2.064-05	2.910-02	4.972-05	9.051-01	3.280-01	2.381-05	6.850-01	7.392-01	2.809+01	7.503-02	3.747-01
3.818-05	2.853-02	5.074-05	9.056-01	3.274-01	2.403-05	6.913-01	7.392-01	2.836+01	4.570-01	6.269-01
6.471-05	2.855-02	5.099-05	9.106-01	3.256-01	2.384-05	6.962-01	7.394-01	2.854+01	1.530+00	8.812-01
1.086-04	2.888-02	5.083-05	9.183-01	3.234-01	2.348-05	7.001-01	7.398-01	2.869+01	4.032+00	1.116+00
1.736-04	2.932-02	5.049-05	9.262-01	3.215-01	2.310-05	7.027-01	7.402-01	2.879+01	8.531+00	1.297+00
2.588-04	2.976-02	5.012-05	9.331-01	3.199-01	2.277-05	7.042-01	7.405-01	2.887+01	1.491+01	1.431+00
4.261-04	3.052-02	4.944-05	9.438-01	3.174-01	2.223-05	7.059-01	7.410-01	2.894+01	1.853+01	1.606+00
7.283-04	3.209-02	4.794-05	9.624-01	3.151-01	2.135-05	7.074-01	7.418-01	2.899+01	2.049+01	1.849+00
1.016-03	3.368-02	4.641-05	9.781-01	3.119-01	2.046-05	7.076-01	7.425-01	2.895+01	2.258+01	2.008+00
1.558-03	3.575-02	4.454-05	9.961-01	3.083-01	1.941-05	7.073-01	7.433-01	2.883+01	2.543+01	2.147+00
2.343-03	3.622-02	4.413-05	9.999-01	3.075-01	1.919-05	7.072-01	7.434-01	2.881+01	2.610+01	2.164+00

DISTANCE FROM WALL,FT

0.000 1.209-05 2.064-05 3.818-05 6.471-05 1.086-04 1.736-04 2.588-04 4.261-04 7.283-04
1.016-03 1.558-03 2.343-03

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

C3 -1.168-02 -2.950-02 -4.121-02 -6.102-02 -8.078-02 -9.864-02 -1.121-01 -1.219-01 -1.345-01 -1.520-01
-1.636-01 -1.743-01 -1.764-01
-1.794-01 -1.831-01 -1.742-01 -1.281-01 -7.285-02 -3.617-02 -1.877-02 -1.096-02 -8.318-03 -5.895-03
-3.572-03 -7.720-04 0.000
-3.732-02 1.361-01 3.513-01 2.811-01 1.119-01 3.539-02 1.191-02 2.018-03 9.858-04 9.453-04
5.696-04 1.866-04 2.284-05

CO 3.625-01 3.678-01 3.713-01 3.771-01 3.830-01 3.883-01 3.923-01 3.952-01 3.990-01 4.042-01
4.076-01 4.108-01 4.114-01
5.329-02 5.438-02 5.173-02 3.806-02 2.164-02 1.074-02 5.576-03 3.256-03 2.471-03 1.751-03
1.061-03 2.293-04 0.000
1.108-02 -4.043-02 -1.043-01 -8.350-02 -3.324-02 -1.051-02 -3.539-03 -5.994-04 -2.928-04 -2.808-04
-1.692-04 -5.541-05 -6.785-06

H 3.253-03 2.901-03 2.670-03 2.279-03 1.888-03 1.536-03 1.269-03 1.077-03 8.270-04 4.821-04
2.524-04 4.156-05 0.000
-3.543-03 -3.615-03 -3.439-03 -2.530-03 -1.438-03 -7.142-04 -3.707-04 -2.165-04 -1.643-04 -1.164-04
-7.053-05 -1.524-05 0.000
-7.369-04 2.688-03 6.936-03 5.551-03 2.210-03 6.988-04 2.353-04 3.985-05 1.947-05 1.867-05
1.125-05 3.684-06 4.510-07

N2 6.459-01 6.588-01 6.673-01 6.816-01 6.959-01 7.088-01 7.186-01 7.256-01 7.347-01 7.474-01
7.558-01 7.635-01 7.650-01
1.297-01 1.323-01 1.259-01 9.259-02 5.265-02 2.614-02 1.357-02 7.923-03 6.012-03 4.261-03
2.581-03 5.579-04 -0.000
2.697-02 -9.836-02 -2.539-01 -2.032-01 -8.088-02 -2.556-02 -8.611-03 -1.458-03 -7.124-04 -6.832-04
-4.116-04 -1.348-04 -1.651-05

MOLE FRACTIONS

C3 1.743-19 1.290-20 4.040-21 7.186-22 1.149-22 1.530-23 2.263-24 4.152-25 2.524-26 7.397-29
1.251-31 1.521-36 0.000

CO	3.102-01	2.548-01	2.204-01	1.707-01	1.276-01	9.201-02	6.716-02	5.059-02	3.139-02	1.115-02	3.303-03	2.451-04	0.000
H	3.955-03	8.396-03	9.790-03	9.368-03	7.517-03	5.493-03	3.978-03	2.964-03	1.813-03	6.506-04	2.119-04	2.586-05	0.000
N2	6.278-01	6.534-01	6.661-01	6.830-01	6.982-01	7.122-01	7.232-01	7.313-01	7.420-01	7.565-01	7.655-01	7.729-01	7.743-01
E-	5.346-11	2.290-09	8.163-09	2.125-08	2.917-08	2.911-08	2.495-08	2.039-08	1.357-08	5.128-09	1.725-09	3.896-10	2.754-10
C+	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
O2	3.432-06	5.120-04	2.844-03	1.267-02	2.847-02	4.723-02	6.441-02	7.865-02	9.985-02	1.353-01	1.534-01	1.916-01	1.974-01
C	1.899-11	7.138-11	1.011-10	9.464-11	5.684-11	2.602-11	1.127-11	5.152-12	1.354-12	7.844-14	3.517-15	2.188-17	0.000
CH	6.161-12	8.785-12	8.133-12	4.875-12	2.169-12	7.909-13	2.904-13	1.174-13	2.593-14	1.098-15	3.455-17	7.317-20	0.000
CHN	1.290-06	2.105-07	9.473-08	3.467-08	1.410-08	5.791-09	2.612-09	1.318-09	4.373-10	4.602-11	3.863-12	3.040-14	0.000
CHO	6.861-06	6.295-06	5.118-06	3.266-06	1.901-06	1.034-06	5.799-07	3.470-07	1.482-07	2.463-08	3.164-09	4.200-11	0.000
CH2	2.646-12	1.036-12	5.632-13	2.008-13	6.524-14	1.925-14	6.167-15	2.276-15	4.474-16	1.581-17	4.033-19	3.534-22	0.000
CH3	1.330-10	1.027-11	2.936-12	5.766-13	1.346-13	3.270-14	9.419-15	3.277-15	6.098-16	2.061-17	4.039-19	2.180-22	0.000
CH4	2.879-11	5.620-13	9.185-14	1.053-14	1.789-15	3.531-16	8.939-17	2.861-17	4.810-18	1.403-19	2.826-21	5.423-25	0.000
CN	4.136-09	4.434-09	4.139-09	2.920-09	1.672-09	8.237-10	4.036-10	2.105-10	7.039-11	6.961-12	5.541-13	7.413-15	0.000
CO2	1.572-02	4.228-02	5.554-02	6.700-02	7.069-02	7.008-02	6.728-02	6.376-02	5.669-02	4.028-02	2.359-02	4.164-03	0.000
C2	4.130-16	3.151-16	2.375-16	1.056-16	3.328-17	8.068-18	1.974-18	5.514-19	6.513-20	7.287-22	5.383-24	1.187-27	0.000
C2H	5.541-13	5.724-14	1.999-14	4.484-15	9.986-16	2.030-16	4.623-17	1.264-17	1.514-18	1.892-20	1.553-22	2.160-26	0.000
C2H2	3.241-12	6.936-14	1.297-14	1.624-15	2.607-16	4.349-17	8.858-18	2.270-18	2.547-19	2.980-21	2.247-23	1.532-27	0.000
C2' 2	4.469-13	3.096-14	1.053-14	2.731-15	7.866-16	2.196-16	6.805-17	2.444-17	4.576-18	1.425-19	3.158-21	3.024-24	0.000
C3H	2.171-17	3.351-19	5.630-20	5.597-21	6.452-22	7.050-23	9.321-24	1.603-24	9.113-26	2.494-28	3.863-31	2.293-36	0.000
C3H2	4.018-19	3.065-21	3.692-22	2.509-23	2.171-24	1.863-25	2.035-26	3.010-27	1.366-28	2.442-31	2.359-34	1.000-30	0.000
C3H3	3.663-20	1.015-22	7.867-24	3.385-25	2.164-26	1.484-27	1.380-28	1.813-29	6.974-31	9.291-34	6.423-37	1.000-30	0.000
HN	4.442-07	1.573-06	2.183-06	2.369-06	1.966-06	1.416-06	9.886-07	7.057-07	3.975-07	1.176-07	3.094-08	2.827-09	0.000
HO	3.256-04	3.326-03	6.678-03	1.084-02	1.249-02	1.232-02	1.135-02	1.026-02	8.395-03	5.157-03	2.796-03	6.434-04	0.000
H2	3.149-02	1.565-02	1.014-02	5.554-03	3.228-03	1.925-03	1.235-03	8.540-04	4.795-04	1.536-04	4.353-05	2.413-06	0.000
H2N	2.031-07	2.231-07	1.892-07	1.255-07	7.642-08	4.429-08	2.669-08	1.719-08	8.437-09	1.984-09	4.007-10	1.406-11	0.000
H2O	1.030-02	1.853-02	1.882-02	1.639-02	1.350-02	1.102-02	9.226-03	7.951-03	6.291-03	3.876-03	2.076-03	2.574-04	0.000
N	3.977-07	4.118-06	9.049-06	1.571-05	1.768-05	1.591-05	1.297-05	1.037-05	6.820-06	2.645-06	9.468-07	2.389-07	1.738-07
NO	1.103-04	2.119-03	5.829-03	1.377-02	2.129-02	2.711-02	3.067-02	3.266-02	3.424-02	3.368-02	3.069-02	2.578-02	2.467-02
O	2.550-05	1.069-03	3.811-03	1.072-02	1.701-02	2.060-02	2.150-02	2.102-02	1.888-02	1.321-02	8.376-03	4.347-03	3.723-03

C4	1.519-26	3.981-28	9.008-29	7.711-30	6.639-31	4.555-32	3.615-33	3.831-34	9.436-36	4.241-39
	1.000-30	1.000-30	0.000							
C5	1.536-37	4.948-33	4.484-34	1.828-35	8.073-37	3.007-38	0.000	1.000-30	1.000-30	1.000-30
	1.000-30	1.000-30	0.000							
C+	4.558-21	9.805-20	2.481-19	3.226-19	1.824-19	6.341-20	1.936-20	6.262-21	8.965-22	1.411-23
	1.417-25	1.685-28	0.000							
N+	1.784-22	4.855-20	3.178-19	1.093-18	1.242-18	7.862-19	3.934-19	1.912-19	5.178-20	2.909-21
	1.349-22	2.296-24	9.008-25							
N2+	2.896-18	1.300-16	4.670-16	1.066-15	1.126-15	7.885-16	4.692-16	2.745-16	1.046-16	1.257-17
	1.321-18	6.707-20	3.385-20							
O2+	2.292-16	7.815-13	1.245-11	1.239-10	3.709-10	6.349-10	7.879-10	8.390-10	7.992-10	5.333-10
	2.868-10	1.096-10	8.675-11							
CO+	1.324-15	2.216-14	5.244-14	7.581-14	5.655-14	2.907-14	1.332-14	6.259-15	1.675-15	9.571-17
	4.115-18	2.398-20	0.000							
NO+	5.349-11	2.297-09	8.237-09	2.173-08	3.028-08	3.069-08	2.666-08	2.204-08	1.496-08	5.891-09
	2.087-09	5.147-10	3.728-10							
O+	1.370-19	9.792-17	8.992-16	4.527-15	7.112-15	6.195-15	4.126-15	2.561-15	1.025-15	1.242-16
	1.238-17	5.613-19	2.751-19							
O2+	1.897-17	2.503-14	2.873-13	1.965-12	4.241-12	5.231-12	4.834-12	4.000-12	2.554-12	7.866-13
	2.000-13	3.030-14	1.954-14							
O-	9.737-15	6.717-12	6.149-11	3.577-10	7.444-10	9.456-10	9.256-10	8.156-10	5.841-10	2.305-10
	7.538-11	1.551-11	1.068-11							

CASE 1 - - - - - - - - - - - - STREAMWISE DIMENSION .36458-00 FEET - - - -24 OCT 69 15:35:46

ITERATED VALUES

ITS	TIME	ALPH	FPP	DAMP	MAX.LIN ERROR	MOMENTUM	ENERGY	C3	CO	H	
1	6,697	4.506	1.3804	,0222	4.-07	7 -8.1+00	4 -3.4+03	4 4.1-01	4 -1.2-01	4 8.1-03	0
2	13,564	4.805	1.5679	,0666	1.-06	7 -7.2+00	4 -3.0+03	4 3.6-01	4 -1.1-01	4 7.1-03	0
3	19,425	5.285	1.8479	,1704	2.-06	7 -6,3+00	4 -2,7+03	4 3.2-01	4 -9.5-02	4 6.3-03	0
4	26,255	5.814	2.1671	,3259	3.-06	7 -4.4+00	4 -2.0+03	4 2.3-01	4 -7.0-02	4 4.6-03	0
5	32,938	6.395	2.4284	,4352	5.-06	8 -2,8+00	5 -1.2+03	5 1.5-01	5 -4.4-02	5 2.9-03	0
6	39,132	6.907	2.6663	1.0000	4.-06	8 -1.7+00	5 -7.5+02	5 9.0-02	5 -2.7-02	5 1.8-03	0
7	45,516	6.802	2.6242	1.0000	2.-06	5 1.1+00	2 1.9+02	2 -3.6-02	2 1.1-02	2 -7.2-04	0
8	51,247	6.794	2.6270	1.0000	5.-07	6 3,7-02	2 -3.4+01	3 -1.7-03	3 4.9-04	3 -3.3-05	0
9	56,437	6.793	2.6271	1.0000	2.-07	6 2.6-03	2 -2.1+00	3 -9.9-05	12 -4.0-05	3 -1.9-06	0
10	61,551	6.793	2.6271	1.0000	5.-07	6 1.3-04	2 -1.2-01	12 7.4-06	12 2.0-05	12 2.9-07	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NORMALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC SQ FT)	RERAD	QCOND
6.793+00	3.757-03	1.000+00	3.650+00	6.914+03	5.633-02	1.121-01	3.526+02	2.776+02	0.000	7.289+02

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
5.780+01	0.000	0.000	8.534-02	8.534-02	-1.433-03	-6,334-02	5.246-02	1.232-02

MOM TRANS COEFF, RHOE*UE*CF/2	HEAT TRANS COEFF, RHOE*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
2,689-01	2.887-01	0,000	2.956-01	2.956-01	3.491-01	3.491-01	3.491-01	3.491-01

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
7,984-04	2.437-03	2,642-03	1.067-03	5.164+06	1.019-03	1.019-03	1.019-03	1.019-03

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTHALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0,000	0.000	-5.295-01	0.000	2.627+00	5.780+01	8.787+02	2.137+03	-4.657+03	8.787+02	4.760+03	4.127+11
8,297-05	1.630-01	-5,097-01	3.166-01	1.257+00	6.327+01	1.165+03	1,378+03	-5.926+03	1.070+03	5.896+03	3.708+11
1,414-04	2.717-01	-4,631-01	4.192-01	6.310-01	6.488+01	1.280+03	7,339+02	-1.799+03	1.112+03	5.939+03	3.694+11
2,573-04	4.891-01	-3,568-01	5.183-01	2.807-01	6.620+01	1.397+03	3.429+02	-4.830+02	1.141+03	5.905+03	3.705+11
4,279-04	8.152-01	-1,752-01	5.879-01	1.461-01	6.673+01	1.483+03	1.854+02	-1.473+02	1.153+03	5.850+03	3.722+11
7,073-04	1.359+00	1,626-01	6.493-01	7.984-02	6.651+01	1.562+03	1,054+02	-5.036+01	1.160+03	5.782+03	3.744+11
1,119-03	2.174+00	7,146-01	7.010-01	4.688-02	6.529+01	1.631+03	6.431+01	-1.799+01	1.162+03	5.709+03	3.768+11
1,656-03	3.261+00	1,501+00	7.435-01	3.144-02	6.305+01	1.691+03	4.476+01	-2.045+00	1.163+03	5.636+03	3.792+11
2,713-03	5.435+00	3.188+00	8.068-01	2.672-02	5.686+01	1.783+03	4.031+01	-3.025+00	1.162+03	5.499+03	3.839+11
4,604-03	9.511+00	6.672+00	8.961-01	1.711-02	4.091+01	1.922+03	2.798+01	-2.916+00	1.156+03	5.209+03	3.945+11
6,389-03	1.359+01	1,045+01	9.500-01	9.340-03	2.491+01	2.012+03	1.609+01	-1.643+00	1.150+03	4.928+03	4.056+11
9,724-03	2,174+01	1,841+01	9.940-01	1.450-03	4.469+00	2.089+03	2.695+00	-4.271-01	1.145+03	4.562+03	4.215+11
1,449-02	3.397+01	3.062+01	1.000+00	0.000	0.000	2.100+03	0.000	-1.363-02	1.145+03	4.447+03	4.269+11

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0,000	2.869-02	4,473-05	9.135-01	3.364-01	2.209-05	6.811-01	7.379-01	2.733+01	0.000	0.000

8.297-05	2.320-02	5.163-05	8.526-01	3.305-01	2.542-05	6.713-01	7.392-01	2.737+01	1.238+00	6.158-01
1.416-04	2.334-02	5.195-05	8.630-01	3.290-01	2.506-05	6.818-01	7.390-01	2.774+01	3.407+00	8.235-01
2.573-04	2.375-02	5.183-05	8.760-01	3.270-01	2.457-05	6.898-01	7.391-01	2.806+01	8.916+00	1.030+00
4.279-04	2.415-02	5.157-05	8.865-01	3.254-01	2.416-05	6.945-01	7.393-01	2.827+01	1.808+01	1.180+00
7.073-04	2.460-02	5.123-05	8.969-01	3.238-01	2.376-05	6.981-01	7.396-01	2.846+01	3.369+01	1.315+00
1.119-03	2.504-02	5.086-05	9.065-01	3.223-01	2.339-05	7.008-01	7.399-01	2.861+01	5.692+01	1.432+00
1.658-03	2.547-02	5.047-05	9.150-01	3.209-01	2.305-05	7.026-01	7.402-01	2.872+01	8.235+01	1.531+00
2.713-03	2.624-02	4.973-05	9.287-01	3.185-01	2.247-05	7.049-01	7.407-01	2.887+01	8.741+01	1.683+00
4.604-03	2.783-02	4.807-05	9.522-01	3.159-01	2.148-05	7.072-01	7.417-01	2.901+01	9.832+01	1.911+00
6.389-03	2.941-02	4.638-05	9.708-01	3.125-01	2.048-05	7.076-01	7.424-01	2.899+01	1.098+02	2.062+00
9.724-03	3.163-02	4.411-05	9.929-01	3.082-01	1.922-05	7.073-01	7.433-01	2.887+01	1.270+02	2.209+00
1.449-02	3.239-02	4.338-05	9.999-01	3.068-01	1.882-05	7.071-01	7.435-01	2.882+01	1.331+02	2.240+00

DISTANCE FROM WALL,FT

0.000 8.297-05 1.416-04 2.573-04 4.279-04 7.073-04 1.119-03 1.658-03 2.713-03 4.604-03
6.389-03 9.724-03 1.449-02

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

C3 3.150-02 -3.135-02 -5.155-02 -7.103-02 -8.471-02 -9.679-02 -1.070-01 -1.155-01 -1.284-01 -1.476-01
-1.604-01 -1.728-01 -1.764-01
-5.232-01 -2.477-01 -1.241-01 -5.514-02 -2.873-02 -1.576-02 -9.324-03 -6.324-03 -5.535-03 -3.868-03
-2.406-03 -6.544-04 0.000
1.690+00 1.137+00 3.172-01 8.100-02 2.386-02 7.893-03 2.760-03 3.629-04 4.091-04 3.587-04
2.148-04 7.070-05 3.634-05

CO 3.497-01 3.683-01 3.743-01 3.801-01 3.842-01 3.878-01 3.908-01 3.933-01 3.972-01 4.028-01
4.066-01 4.104-01 4.114-01
1.554-01 7.358-02 3.686-02 1.638-02 8.532-03 4.681-03 2.770-03 1.879-03 1.644-03 1.149-03
7.146-04 1.944-04 0.000
-5.019-01 -3.379-01 -9.421-02 -2.406-02 -7.087-03 -2.344-03 -8.197-04 -1.078-04 -1.215-04 -1.066-04
-6.382-05 -2.100-05 -1.079-05

H 4.106-03 2.865-03 2.466-03 2.081-03 1.811-03 1.572-03 1.370-03 1.202-03 9.478-04 5.694-04
3.169-04 7.055-05 0.000
-1.033-02 -4.892-03 -2.450-03 -1.089-03 -5.672-04 -3.112-04 -1.841-04 -1.249-04 -1.093-04 -7.638-05
-4.751-05 -1.292-05 0.000
3.337-02 2.246-02 6.263-03 1.599-03 4.711-04 1.559-04 5.450-05 7.165-06 8.078-06 7.083-06
4.242-06 1.396-06 7.175-07

N2 6.147-01 6.602-01 6.748-01 6.888-01 6.987-01 7.075-01 7.148-01 7.210-01 7.303-01 7.442-01
7.534-01 7.624-01 7.650-01
3.781-01 1.790-01 8.968-02 3.985-02 2.076-02 1.139-02 6.739-03 4.571-03 4.001-03 2.795-03
1.739-03 4.729-04 -0.000
-1.221+00 -8.221-01 -2.292-01 -5.854-02 -1.724-02 -5.704-03 -1.995-03 -2.622-04 -2.957-04 -2.592-04
-1.553-04 -5.109-05 -2.626-05

MOLE FRACTIONS

C3 2.273-05 9.130-20 9.047-21 1.038-21 1.972-22 3.768-23 7.596-24 1.650-24 1.001-25 2.223-28
2.866-31 2.293-36 0.000

CO 3.411-01 2.569-01 2.063-01 1.600-01 1.289-01 1.025-01 8.115-02 6.442-02 4.140-02 1.483-02
4.443-03 3.729-04 0.000

H 3.538-03 2.018-02 1.631-02 1.209-02 9.290-03 7.039-03 5.341-03 4.090-03 2.498-03 8.547-04
2.679-04 3.296-05 0.000

N2 5.737-01 6.414-01 6.611-01 6.797-01 6.929-01 7.047-01 7.148-01 7.233-01 7.360-01 7.540-01
7.647-01 7.736-01 7.759-01

E- 4.144-13 2.932-08 4.685-08 5.110-08 4.736-08 4.070-08 3.354-08 2.710-08 1.747-08 6.006-09
1.807-09 2.927-10 1.537-10

C+ 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000

O2 1.541-15 2.768-03 1.022-02 2.221-02 3.355-02 4.574-02 5.781-02 6.922-02 8.924-02 1.263-01
1.566-01 1.895-01 1.991-01

C	1.056-04	9.133-10	4.770-10	2.198-10	1.037-10	4.891-11	2.303-11	1.106-11	2.810-12	1.350-13	4.275-15	2.002-17	0.000
CH	2.669-07	5.671-11	2.176-11	7.683-12	3.284-12	1.374-12	5.838-13	2.563-13	5.607-14	2.024-15	5.473-17	9.531-20	0.000
CHN	4.984-02	2.095-07	7.237-08	2.846-08	1.434-08	7.373-09	3.920-09	2.163-09	7.359-10	7.268-11	5.833-12	5.083-14	0.000
CHO	5.876-04	7.818-06	4.897-06	2.895-06	1.876-06	1.198-06	7.681-07	4.988-07	2.225-07	3.656-08	4.715-09	7.779-11	0.000
CH2	4.927-08	2.602-12	7.205-13	2.060-13	7.828-14	2.989-14	1.182-14	4.897-15	9.824-16	3.082-17	7.177-19	6.873-22	0.000
CH3	3.495-04	7.636-12	1.499-12	3.520-13	1.218-13	4.374-14	1.664-14	6.735-15	1.324-15	4.198-17	9.911-19	6.641-22	0.000
CH4	5.890-07	1.523-13	2.147-14	4.096-15	1.267-15	4.183-16	1.493-16	5.752-17	1.053-17	3.013-19	6.377-21	2.495-24	0.000
CN	2.052-04	1.843-08	9.111-09	4.313-09	2.344-09	1.252-09	6.741-10	3.709-10	1.224-10	1.063-11	7.404-13	7.620-15	0.000
CO2	3.417-07	3.153-02	4.527-02	5.477-02	5.948-02	6.216-02	6.307-02	6.264-02	5.929-02	4.594-02	2.936-02	7.121-03	0.000
C2	1.112-06	4.061-15	9.431-16	2.090-16	6.222-17	1.807-17	5.366-18	1.669-18	1.925-19	1.681-21	9.655-24	1.322-27	0.000
C2H	1.162-03	1.602-13	2.582-14	4.779-15	1.330-15	3.760-16	1.116-16	3.522-17	4.289-18	4.494-20	3.152-22	3.977-26	0.000
C2H2	5.295-03	6.030-14	6.910-15	1.047-15	2.643-16	6.986-17	1.982-17	6.076-18	7.167-19	7.407-21	5.138-23	4.391-27	0.000
C2N2	9.575-04	4.629-14	9.689-15	2.451-15	8.840-16	3.254-16	1.249-16	5.039-17	9.584-18	2.598-19	5.049-21	4.185-24	0.000
C3H	2.205-03	7.396-19	5.212-20	4.898-21	8.430-22	1.506-22	2.903-23	6.118-24	3.590-25	7.846-28	9.974-31	5.374-36	0.000
C3H2	3.179-05	4.302-21	2.263-22	1.677-23	2.459-24	3.796-25	6.412-26	1.200-26	5.735-28	8.314-31	6.805-34	1.000-30	0.000
C3H3	2.257-06	6.912-23	2.662-24	1.580-25	2.021-26	2.779-27	4.256-28	7.317-29	3.010-30	3.381-33	2.075-36	1.000-30	0.000
HN	3.544-07	5.226-06	4.405-06	3.242-06	2.430-06	1.776-06	1.293-06	9.473-07	5.295-07	1.467-07	3.630-08	3.130-09	0.000
HO	5.758-09	8.016-03	1.182-02	1.345-02	1.358-02	1.309-02	1.227-02	1.132-02	9.453-03	5.894-03	3.259-03	8.702-04	0.000
H2	2.194-02	1.276-02	7.371-03	4.457-03	3.082-03	2.164-03	1.555-03	1.143-03	6.619-04	2.121-04	6.193-05	4.693-06	0.000
H2'	1.262-07	3.172-07	1.942-07	1.152-07	7.612-08	5.025-08	3.365-08	2.301-08	1.152-08	2.629-09	5.276-10	2.282-11	0.000
H2O	1.419-07	1.203-02	1.249-02	1.173-02	1.088-02	9.963-03	9.086-03	8.284-03	6.937-03	4.606-03	2.732-03	5.541-04	0.000
N	4.074-07	2.950-05	3.406-05	3.124-05	2.673-05	2.182-05	1.743-05	1.383-05	8.792-06	3.092-06	9.908-07	1.830-07	1.014-07
NO	2.234-09	6.962-03	1.391-02	2.041-02	2.456-02	2.781-02	3.016-02	3.176-02	3.339-02	3.302-02	2.990-02	2.408-02	2.213-02
O	5.791-10	7.356-03	1.513-02	2.115-02	2.380-02	2.484-02	2.469-02	2.381-02	2.115-02	1.434-02	8.679-03	3.874-03	2.898-03
C4	9.594-08	4.512-27	2.051-28	1.151-29	1.272-30	1.420-31	1.707-32	2.266-33	5.579-35	1.745-38	1.000-30	1.000-30	0.000
C5	4.696-07	3.761-32	7.395-34	2.126-35	1.473-36	1.059-37	8.426-39	1.000-30	1.000-30	1.000-30	1.000-30	1.000-30	0.000
C+	3.758-14	1.064-17	4.731-18	1.509-18	5.390-19	1.788-19	5.875-20	1.982-20	2.602-21	2.940-23	2.374-25	1.065-28	0.000
N+	2.709-20	1.035-17	1.106-17	6.854-18	3.822-18	1.910-18	9.139-19	4.356-19	1.057-19	4.363-21	1.443-22	9.737-25	1.716-25
N2+	3.922-16	5.748-15	5.640-15	3.832-15	2.456-15	1.460-15	8.433-16	4.869-16	1.711-16	1.638-17	1.342-18	3.459-20	9.730-21
O2-	6.940-28	2.746-11	1.561-10	3.809-10	5.593-10	6.963-10	7.750-10	8.020-10	7.591-10	4.953-10	2.521-10	7.740-11	4.983-11

CO+	2.158-13	5.397-13	3.956-13	2.096-13	1.120-13	5.576-14	2.714-14	1.329-14	3.427-15	1.618-16
	5.673-18	2.095-20	0.000							
NO+	1.606-13	2.957-08	4.771-08	3.260-08	4.918-08	4.264-08	3.544-08	2.887-08	1.890-08	6.746-09
	2.130-09	3.804-10	2.087-10							
O+	4.611-22	1.404-14	2.611-14	2.512-14	1.900-14	1.262-14	7.846-15	4.753-15	1.756-15	1.702-16
	1.317-17	2.948-19	7.835-20							
O2+	1.263-24	1.640-12	5.275-12	8.120-12	8.641-12	7.963-12	6.726-12	5.413-12	3.308-12	9.036-13
	1.980-13	1.941-14	8.568-15							
O-	1.492-21	2.287-10	7.114-10	1.133-09	1.269-09	1.246-09	1.127-09	9.718-10	6.769-10	2.459-10
	7.189-11	1.035-11	5.156-12							

CASE 1 - - - - - - - - - - - - STREAMWISE DIMENSION .69792-00 FEET - - - -24 OCT 69 15:36:48

ITERATED VALUES / MAX,ERRORS IN CONSERVATION EQS.

ITS	TIME	ALPH	FPPW	CAMP	MAX,LIN ERROR		MOMENTUM		ENERGY		C3		CO		H	
1	6.385	7.228	3.0088	.4999	2.-07	5	-7.5+00	2	-1.3+03	2	2.8-01	2	-8.4-02	2	5.6-03	0
2	12.217	7.569	3.24011	.0000	3.-06	5	-3.2+00	2	-5.1+02	2	1.1-01	2	-3.4-02	2	2.2-03	0
3	17.962	7.558	3.23811	.0000	2.-06	8	-7.9-02	10	1.5+01	5	3.2-03	5	-9.4-04	5	6.3-05	0
4	23.166	7.557	3.23851	.0000	2.-06	7	-4.8-03	2	-4.6+00	4	1.6-04	4	-4.9-05	4	3.2-06	0
5	28.374	7.557	3.23851	.0000	1.-06	15	3.4-04	2	-2.1-01	4	8.0-06	12	-2.3-05	12	4.7-07	0
6	33.551	7.557	3.23851	.0000	1.-06	15	7.8-05	12	6.6-02	12	9.1-06	12	-4.3-05	12	6.9-07	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC	RERAD SQ FT)	QCOND
7.557+00	6.814-03	1.000+00	3.142+00	7.076+03	1.004-01	7.409-02	2.747+02	2.091+02	0.000	5.884+02

ALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
4.789+01	0.000	0.000	7.086-02	7.086-02	-1.180-03	-5.217-02	4.320-02	1.014-02

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
2.177-01	2.339-01	0.000	3.029-01	3.029-01	2.782-01	2.782-01	2.782-01	2.782-01

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
1.299-03	4.257-03	4.616-03	1.607-03	4.775+06	1.733-03	1.733-03	1.733-03	1.734-03

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	-6.236-01	0.000	3.239+00	4.789+01	9.258+02	2.558+03	-8.221+03	9.258+02	4.760+03	3.553+11
1.434-04	1.814-01	-5.828-01	3.611-01	9.633+01	5.343+01	1.254+03	1.067+03	-4.293+03	1.109+03	5.928+03	3.183+11
2.430-04	3.023-01	-5.309-01	4.679-01	4.728-01	5.451+01	1.352+03	5.476+02	-1.175+03	1.133+03	5.924+03	3.184+11
4.390-04	5.441-01	-4.064-01	5.514-01	2.182-01	5.526+01	1.450+03	2.635+02	-3.201+02	1.146+03	5.876+03	3.197+11
7.277-04	9.069-01	-1.942-01	6.124-01	1.179-01	5.538+01	1.525+03	1.473+02	-1.023+02	1.150+03	5.817+03	3.213+11
1.200-03	1.511+00	1.944-01	6.680-01	6.605-02	5.488+01	1.595+03	8.552+01	-3.614+01	1.149+03	5.747+03	3.233+11
1.896-03	2.418+00	8.237-01	7.158-01	3.924-02	5.361+01	1.658+03	5.274+01	-1.286+01	1.145+03	5.672+03	3.254+11
2.807-03	3.628+00	1.715+00	7.556-01	2.665-02	5.159+01	1.712+03	3.720+01	-1.546+00	1.141+03	5.597+03	3.276+11
4.587-03	6.046+00	3.616+00	8.151-01	2.254-02	4.643+01	1.798+03	3.346+01	-2.206+00	1.133+03	5.457+03	3.318+11
7.772-03	1.058+01	7.516+00	8.990-01	1.447-02	3.369+01	1.927+03	2.346+01	-2.124+00	1.118+03	5.159+03	3.413+11
1.077-02	1.511+01	1.172+01	9.500-01	8.034-03	2.101+01	2.011+03	1.383+01	-1.224+00	1.109+03	4.864+03	3.515+11
1.634-02	2.418+01	2.057+01	9.929-01	1.435-03	4.405+00	2.086+03	2.722+00	-3.518-01	1.100+03	4.466+03	3.668+11
2.423-02	3.779+01	3.415+01	1.000+00	0.000	0.000	2.100+03	0.000	-4.846-02	1.100+03	4.320+03	3.729+11

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	2.480-02	4.473-05	9.075-01	3.380-01	2.206-05	6.855-01	7.376-01	2.743+01	0.000	0.000
1.434-04	1.991-02	5.183-05	8.443-01	3.300-01	2.538-05	6.740-01	7.391-01	2.744+01	2.559+00	7.600-01
2.430-04	2.015-02	5.187-05	8.553-01	3.284-01	2.495-05	6.828-01	7.390-01	2.775+01	6.219+00	9.430-01
4.390-04	2.053-02	5.166-05	8.678-01	3.267-01	2.446-05	6.898-01	7.391-01	2.804+01	1.467+01	1.125+00
7.277-04	2.089-02	5.138-05	8.783-01	3.252-01	2.406-05	6.943-01	7.393-01	2.825+01	2.793+01	1.261+00

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1.200-03  2.129-02  5.102-05  8.888-01  3.237-01  2.367-05  6.978-01  7.396-01  2.844+01  5.010+01  1.389+00
1.896-03  2.169-02  5.064-05  8.986-01  3.222-01  2.330-05  7.004-01  7.399-01  2.860+01  8.294+01  1.502+00
2.807-03  2.208-02  5.024-05  9.075-01  3.209-01  2.295-05  7.024-01  7.402-01  2.872+01  1.179+02  1.599+00
4.587-03  2.278-02  4.948-05  9.220-01  3.185-01  2.236-05  7.048-01  7.407-01  2.889+01  1.255+02  1.748+00
7.772-03  2.422-02  4.777-05  9.467-01  3.160-01  2.134-05  7.071-01  7.416-01  2.904+01  1.419+02  1.974+00
1.077-02  2.568-02  4.599-05  9.664-01  3.124-01  2.031-05  7.076-01  7.424-01  2.903+01  1.596+02  2.126+00
1.634-02  2.784-02  4.351-05  9.909-01  3.078-01  1.894-05  7.072-01  7.433-01  2.890+01  1.874+02  2.281+00
2.423-02  2.871-02  4.256-05  9.999-01  3.061-01  1.843-05  7.069-01  7.436-01  2.883+01  1.994+02  2.322+00

                                DISTANCE FROM WALL,FT
          0.000      1.434-04  2.430-04  4.390-04  7.277-04  1.200-03  1.896-03  2.807-03  4.587-03  7.772-03
               1.077-02  1.634-02  2.423-02

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

   C3      3.844-02 -3.855-02 -5.595-02 -7.270-02 -8.496-02 -9.620-02 -1.060-01 -1.142-01 -1.270-01 -1.461-01
               -1.590-01 -1.720-01 -1.764-01
          -6.558-01 -1.931-01 -9.473-02 -4.378-02 -2.378-02 -1.343-02 -8.093-03 -5.597-03 -4.927-03 -3.493-03
               -2.216-03 -6.583-04  0.000
           2.551+00  8.137-01  2.107-01  5.514-02  1.711-02  5.889-03  2.064-03  2.770-04  3.163-04  2.814-04
                1.718-04  5.168-05  4.511-05
   CO      3.476-01  3.705-01  3.756-01  3.806-01  3.842-01  3.876-01  3.905-01  3.929-01  3.967-01  4.024-01
                4.062-01  4.101-01  4.114-01
           1.948-01  5.736-02  2.814-02  1.300-02  7.063-03  3.990-03  2.404-03  1.662-03  1.463-03  1.037-03
                6.583-04  1.955-04  0.000
          -7.577-01 -2.417-01 -6.259-02 -1.638-02 -5.082-03 -1.749-03 -6.131-04 -8.229-05 -9.397-05 -8.360-05
               -5.103-05 -1.535-05 -1.340-05
   H       4.243-03  2.722-03  2.379-03  2.048-03  1.806-03  1.584-03  1.391-03  1.228-03  9.764-04  5.994-04
                3.438-04  8.642-05  0.000
          -1.295-02 -3.814-03 -1.871-03 -8.645-04 -4.695-04 -2.653-04 -1.598-04 -1.105-04 -9.729-05 -6.897-05
               -4.377-05 -1.300-05  0.000
           5.037-02  1.607-02  4.161-03  1.089-03  3.379-04  1.163-04  4.076-05  5.470-06  6.247-06  5.558-06
                3.393-06  1.020-06  8.908-07
   N2      6.097-01  6.654-01  6.779-01  6.900-01  6.989-01  7.070-01  7.141-01  7.201-01  7.293-01  7.431-01
                7.524-01  7.618-01  7.650-01
           4.739-01  1.396-01  6.847-02  3.164-02  1.718-02  9.709-03  5.849-03  4.045-03  3.561-03  2.524-03
                1.602-03  4.758-04 -0.000
          -1.843+00 -5.881-01 -1.523-01 -3.985-02 -1.237-02 -4.256-03 -1.492-03 -2.002-04 -2.286-04 -2.034-04
               -1.242-04 -3.735-05 -3.260-05

MOLE FRACTIONS

   C3      4.802-05  3.422-20  4.658-21  6.688-22  1.409-22  2.845-23  5.863-24  1.271-24  7.441-26  1.462-28
                1.463-31  6.825-37  0.000
   CO      3.404-01  2.396-01  1.969-01  1.571-01  1.289-01  1.038-01  8.300-02  6.623-02  4.274-02  1.531-02
                4.511-03  3.759-04  0.000
   H       3.507-03  2.044-02  1.626-02  1.224-02  9.529-03  7.279-03  5.542-03  4.243-03  2.577-03  8.660-04
                2.613-04  3.024-05  0.000
   N2      5.677-01  6.467-01  6.638-01  6.803-01  6.926-01  7.042-01  7.143-01  7.229-01  7.359-01  7.545-01
                7.456-01  7.748-01  7.774-01
   E-      4.334-13  4.103-08  5.108-08  5.092-08  4.596-08  3.895-08  3.176-08  2.539-08  1.603-08  5.244-09
                1.448-09  1.870-10  7.910-11
   C*      0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
                0.000     0.000     0.000
   O2      8.865-16  5.141-03  1.283-02  2.373-02  3.401-02  4.531-02  5.673-02  6.772-02  8.730-02  1.241-01
                1.547-01  1.891-01  2.009-01
   C       1.498-06  7.976-10  4.068-10  1.851-10  9.308-11  4.437-11  2.089-11  9.937-12  2.448-12  1.077-13
                3.376-15  9.282-18  0.000
   CH      3.230-07  4.017-11  1.643-11  6.280-12  2.808-12  1.204-12  5.163-13  2.261-13  4.841-14  1.630-15
                3.836-17  5.021-20  0.000
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CH	5.567-02	1.262-07	5.287-08	2.345-08	1.250-08	6.640-09	3.591-09	1.994-09	6.770-10	6.540-11	4.745-12	3.964-14	0.000
CHO	2.005-06	6.187-06	4.157-06	2.539-06	1.704-06	1.114-06	7.251-07	4.745-07	2.125-07	3.476-08	4.343-09	7.393-11	0.000
CH2	9.219-08	1.475-12	4.447-13	1.586-13	6.461-14	2.568-14	1.036-14	4.315-15	8.579-16	2.576-17	5.404-19	4.415-22	0.000
CH3	3.381-06	3.416-12	9.035-13	2.587-13	9.844-14	3.742-14	1.470-14	6.038-15	1.194-15	3.743-17	6.340-19	5.577-22	0.000
CH4	4.431-07	5.430-14	1.155-14	2.845-15	9.922-16	3.522-16	1.312-16	5.174-17	9.660-18	2.807-19	5.822-21	2.601-24	0.000
CN	2.685-04	1.422-08	7.393-09	3.689-09	2.063-09	1.118-09	6.048-10	3.313-10	1.072-10	8.770-12	5.437-13	4.300-15	0.000
CO2	2.400-07	3.520-02	4.599-02	5.419-02	5.882-02	6.189-02	6.336-02	6.349-02	6.104-02	4.374-02	3.221-02	8.812-03	0.000
C2	1.925-06	2.369-15	6.228-16	1.550-16	4.905-17	1.470-17	4.406-18	1.360-18	1.513-19	1.180-21	5.436-24	4.539-26	0.000
C2H	1.717-03	7.233-14	1.539-14	3.431-15	1.044-15	3.100-16	9.410-17	2.982-17	3.548-18	3.476-20	2.075-22	1.934-26	0.000
C2H2	6.675-03	2.153-14	3.685-15	7.158-16	2.026-16	5.720-17	1.680-17	5.217-18	6.136-19	6.086-21	3.760-23	2.767-27	0.000
C2H2	1.412-03	2.109-14	5.760-15	1.718-15	6.666-16	2.553-16	9.979-17	4.037-17	7.568-18	1.932-19	3.287-21	2.084-24	0.000
C3H	3.975-03	2.194-19	2.418-20	3.004-21	5.886-22	1.129-22	2.251-23	4.779-24	2.747-25	5.478-28	5.655-31	2.070-36	0.000
C3H2	4.891-05	1.047-21	9.246-23	9.473-24	1.614-24	2.711-25	4.780-26	9.063-27	4.274-28	5.729-31	3.863-34	1.000-30	0.000
C3H3	2.963-06	1.361-23	9.642-25	8.324-26	1.266-26	1.922-27	3.101-28	5.440-29	2.252-30	2.361-33	1.223-36	1.000-30	0.000
HN	3.242-07	5.033-06	4.047-06	2.991-06	2.263-06	1.665-06	1.214-06	8.875-07	4.914-07	1.323-07	3.099-08	2.400-09	0.000
HO	4.018-09	9.868-03	1.246-02	1.354-02	1.356-02	1.307-02	1.227-02	1.134-02	9.500-03	5.943-03	3.280-03	9.008-04	0.000
H2	1.856-02	1.026-02	6.565-03	4.280-03	3.075-03	2.212-03	1.612-03	1.196-03	6.980-04	2.260-04	6.614-05	5.422-06	0.000
H2N	9.856-08	2.456-07	1.586-07	9.969-08	6.811-08	4.592-08	3.113-08	2.140-08	1.074-08	2.435-09	4.766-10	2.077-11	0.000
H2O	8.451-03	1.163-02	1.182-02	1.132-02	1.069-02	9.958-03	9.214-03	8.501-03	7.254-03	5.005-03	3.115-03	7.678-04	0.000
N	4.368-07	3.520-05	3.525-05	3.083-05	2.603-05	2.107-05	1.669-05	1.312-05	8.178-06	2.739-06	8.086-07	1.208-07	5.490-08
NO	1.686-09	9.701-03	1.549-02	2.076-02	2.426-02	2.711-02	2.922-02	3.068-02	3.213-02	3.156-02	2.823-02	2.196-02	1.955-02
O	4.734-10	1.138-02	1.787-02	2.248-02	2.448-02	2.514-02	2.476-02	2.372-02	2.085-02	1.379-02	8.017-03	3.212-03	2.173-03
C4	2.474-07	1.152-27	8.144-29	6.132-30	7.787-31	9.362-32	1.159-32	1.536-33	3.614-35	9.632-39	1.000-30	1.000-30	0.000
C5	1.479-06	6.260-33	2.295-34	9.749-36	8.090-37	6.403-38	5.313-39	1.000-30	1.000-30	1.000-30	1.000-30	1.000-30	0.000
C+	5.918-14	9.742-18	3.885-18	1.250-18	4.550-19	1.516-19	4.936-20	1.630-20	2.020-21	1.956-23	1.205-25	2.802-29	0.000
N+	3.226-20	1.330-17	1.073-17	6.024-18	3.274-18	1.604-18	7.504-19	3.480-19	7.953-20	2.831-21	7.335-23	2.647-25	2.608-26
N2+	4.311-16	6.613-15	5.255-15	3.350-15	2.112-15	1.238-15	7.042-16	3.986-16	1.340-16	1.151-17	7.886-19	1.286-20	2.366-21
O2-	3.596-28	5.974-11	1.862-10	3.581-10	4.877-10	5.863-10	6.410-10	6.561-10	6.115-10	3.859-10	1.853-10	4.828-11	2.659-11
CO+	2.392-13	5.562-13	3.551-13	1.850-13	9.961-14	4.974-14	2.411-14	1.167-14	2.908-15	1.250-16	3.699-16	9.180-21	0.000
NO+	1.346-13	4.150-08	5.206-08	5.234-08	4.758-08	4.061-08	3.336-08	2.687-08	1.720-08	5.822-09	1.685-09	2.410-10	1.079-10

0+	4.187-22	2.382-14	2.910-14	2.417-14	1.751-14	1.134-14	6.897-15	4.083-15	1.439-15	1.244-16
	7.981-18	1.104-19	1.876-20							
02+	8.069-25	3.249-12	6.326-12	8.053-12	8.081-12	7.225-12	5.982-12	4.734-12	2.806-12	7.132-13
	1.389-13	1.005-14	3.357-15							
0-	1.098-21	4.088-10	8.029-10	1.073-09	1.138-09	1.089-09	9.688-10	8.245-10	5.611-10	1.930-10
	5.138-11	5.747-12	2.254-12							

CASE 1 - - - - - - - - - - - - - STREAMWISE DIMENSION .11562+01 FEET - - - -24 OCT 69 15:37:22

ITERATED VALUES

ITS	TIME	ALPH	FPP*	DAMP	MAX.LIN ERROR		MAX.ERRORS IN CONSERVATION EQS. MOMENTUM		ENERGY		C3		CO		H	
1	6.641	7.858	3.4669	.4999	5.-07	5	-4.9+00	2	-1.3+03	2	3.0-01	2	-8.9-02	2	5.9-03	0
2	12.470	8.135	3.6043	1.0000	1.-06	5	-3.4+00	12	5.5+02	12	-1.1-01	12	3.4-02	12	-2.3-03	0
3	18.186	8.130	3.6027	1.0000	2.-06	5	7.7-02	10	1.5+01	13	3.7-03	13	-1.2-03	13	7.3-05	0
4	23.396	8.130	3.6029	1.0000	5.-07	7	-4.1-03	2	-2.3+00	4	1.4-04	4	-4.3-05	4	2.7-06	0
5	28.604	8.130	3.6029	1.0000	1.-06	15	5.9-04	12	1.4-01	12	-1.2-05	12	-5.6-05	12	-2.5-07	0
6	33.812	8.130	3.6029	1.0000	2.-06	15	4.8-04	12	-7.9-02	12	4.1-06	12	-6.0-05	12	1.5-07	0
7	39.019	8.130	3.6029	1.0000	1.-06	15	-9.4-04	12	1.6-01	12	2.3-05	12	7.8-05	12	7.3-07	0
8	44.228	8.130	3.6029	1.0000	2.-06	15	4.7-04	12	-4.2-02	7	4.6-06	12	-2.2-05	12	-3.7-07	0
9	49.436	8.130	3.6029	1.0000	1.-06	7	3.6-05	12	1.1-01	12	1.8-06	13	2.2-06	12	2.9-08	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NORMALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC SQ FT)	RERAD SQ FT)	QCOND
8.130+00	1.051-02	1.000+00	2.643+00	7.253+03	1.286-01	5.206-02	1.900+02	1.303+02	0.000	4.564+02

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
3.814+01	0.000	0.000	5.907-02	5.907-02	-9.706-04	-4.287-02	3.550-02	8.335-03

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
1.692-01	1.744-01	0.000	3.387-01	3.387-01	2.165-01	2.165-01	2.165-01	2.165-01

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
1.913-03	6.823-03	7.390-03	2.873-03	4.357+06	2.607-03	2.607-03	2.607-03	2.607-03

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTHALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	-7.088-01	0.000	3.603+00	3.814+01	1.010+03	2.542+03	-8.856+03	1.010+03	4.760+03	2.988+11
2.247-04	1.951-01	-6.582-01	4.276-01	7.798-01	4.342+01	1.338+03	8.135+02	-3.017+03	1.146+03	5.942+03	2.674+11
3.793-04	3.252-01	-5.970-01	5.034-01	3.862-01	4.418+01	1.418+03	4.210+02	-8.126+02	1.152+03	5.911+03	2.681+11
6.825-04	5.854-01	-4.553-01	5.776-01	1.837-01	4.469+01	1.500+03	2.096+02	-2.287+02	1.150+03	5.848+03	2.695+11
1.126-03	9.756-01	-2.180-01	6.332-01	1.014-01	4.473+01	1.565+03	1.203+02	-7.563+01	1.143+03	5.783+03	2.711+11
1.857-03	1.626+00	2.122-01	6.849-01	5.747-02	4.428+01	1.627+03	7.116+01	-2.736+01	1.134+03	5.707+03	2.729+11
2.927-03	2.602+00	9.041-01	7.297-01	3.434-02	4.322+01	1.683+03	4.447+01	-9.939+00	1.124+03	5.627+03	2.748+11
4.328-03	3.902+00	1.879+00	7.671-01	2.328-02	4.156+01	1.733+03	3.154+01	-1.138+00	1.114+03	5.548+03	2.767+11
7.056-03	6.504+00	3.950+00	8.230-01	1.963-02	3.742+01	1.811+03	2.858+01	-1.683+00	1.099+03	5.402+03	2.805+11
1.193-02	1.136+01	8.170+00	9.017-01	1.266-02	2.743+01	1.930+03	2.037+01	-1.651+00	1.076+03	5.095+03	2.888+11
1.651-02	1.626+01	1.270+01	9.500-01	7.143-03	1.752+01	2.010+03	1.231+01	-9.783-01	1.062+03	4.787+03	2.979+11
2.495-02	2.602+01	2.222+01	9.918-01	1.433-03	4.195+00	2.083+03	2.767+00	-2.932-01	1.050+03	4.358+03	3.122+11
3.682-02	4.065+01	3.682+01	1.000+00	0.000	0.000	2.100+03	0.000	-8.502-02	1.049+03	4.174+03	3.190+11

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	2.098-02	4.473-05	9.020-01	3.408-01	2.204-05	6.917-01	7.371-01	2.760+01	0.000	0.000
2.247-04	1.667-02	5.189-05	8.315-01	3.298-01	2.541-05	6.734-01	7.390-01	2.738+01	3.913+00	8.731-01

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3.793-04  1.695-02  5.177-05  8.435-01  3.282-01  2.492-05  6.820-01  7.390-01  2.769+01  8.906+00  1.041+00
6.825-04  1.732-02  5.148-05  8.570-01  3.265-01  2.439-05  6.891-01  7.391-01  2.799+01  1.987+01  1.209+00
1.128-03  1.766-02  5.116-05  8.681-01  3.250-01  2.397-05  6.937-01  7.393-01  2.822+01  3.670+01  1.340+00
1.857-03  1.802-02  5.078-05  8.795-01  3.235-01  2.356-05  6.973-01  7.396-01  2.842+01  6.477+01  1.465+00
2.927-03  1.839-02  5.037-05  8.900-01  3.221-01  2.317-05  7.001-01  7.399-01  2.859+01  1.063+02  1.577+00
4.328-03  1.874-02  4.995-05  8.995-01  3.207-01  2.282-05  7.022-01  7.402-01  2.873+01  1.512+02  1.673+00
7.058-03  1.937-02  4.916-05  9.148-01  3.183-01  2.220-05  7.047-01  7.407-01  2.891+01  1.615+02  1.820+00
1.193-02  2.065-02  4.739-05  9.407-01  3.159-01  2.117-05  7.071-01  7.417-01  2.908+01  1.837+02  2.044+00
1.651-02  2.198-02  4.553-05  9.615-01  3.123-01  2.009-05  7.076-01  7.424-01  2.907+01  2.080+02  2.197+00
2.495-02  2.402-02  4.282-05  9.883-01  3.073-01  1.861-05  7.071-01  7.433-01  2.893+01  2.484+02  2.362+00
3.682-02  2.500-02  4.162-05  9.999-01  3.032-01  1.797-05  7.068-01  7.437-01  2.884+01  2.691+02  2.416+00

                         DISTANCE FROM WALL,FT
          0.000     2.247-04  3.793-04  6.825-04  1.128-03  1.857-03  2.927-03  4.328-03  7.058-03  1.193-02
               1.651-02  2.495-02  3.682-02

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

   C3     5.047-02 -4.083-02 -5.684-02 -7.249-02 -8.426-02 -9.526-02 -1.049-01 -1.131-01 -1.257-01 -1.447-01
              -1.577-01 -1.711-01 -1.764-01
         -7.711-01 -1.647-01 -8.148-02 -3.881-02 -2.152-02 -1.230-02 -7.456-03 -5.152-03 -4.532-03 -3.239-03
              -2.092-03 -6.706-04  0.000
          3.198+00  6.397-01  1.640-01  4.430-02  1.418-02  4.968-03  1.771-03  2.384-04  2.651-04  2.351-04
               1.457-04  3.533-05  5.632-05
   CO     3.440-01  3.711-01  3.759-01  3.805-01  3.840-01  3.873-01  3.902-01  3.926-01  3.963-01  4.020-01
               4.058-01  4.098-01  4.114-01
          2.290-01  4.892-02  2.420-02  1.153-02  6.393-03  3.654-03  2.215-03  1.530-03  1.346-03  9.621-04
               6.213-04  1.992-04  0.000
         -9.231-01 -1.900-01 -4.871-02 -1.316-02 -4.211-03 -1.476-03 -5.260-04 -7.081-05 -7.873-05 -6.985-05
              -4.327-05 -1.049-05 -1.673-05
   H      4.480-03  2.677-03  2.361-03  2.052-03  1.820-03  1.602-03  1.412-03  1.250-03  1.001-03  6.271-04
               3.704-04  1.043-04  0.000
         -1.523-02 -3.252-03 -1.609-03 -7.664-04 -4.250-04 -2.429-04 -1.472-04 -1.017-04 -8.949-05 -6.396-05
              -4.131-05 -1.324-05  0.000
          6.137-02  1.263-02  3.238-03  8.747-04  2.799-04  9.810-05  3.497-05  4.708-06  5.234-06  4.643-06
               2.877-06  6.976-07  1.112-06
   N2     6.010-01  6.670-01  6.786-01  6.899-01  6.984-01  7.064-01  7.133-01  7.192-01  7.283-01  7.420-01
               7.514-01  7.612-01  7.650-01
          5.573-01  1.190-01  5.889-02  2.805-02  1.556-02  8.891-03  5.388-03  3.724-03  3.275-03  2.341-03
               1.512-03  4.846-04 -0.000
         -2.246+00 -4.623-01 -1.185-01 -3.201-02 -1.025-02 -3.590-03 -1.280-03 -1.723-04 -1.916-04 -1.699-04
              -1.053-04 -2.553-05 -4.070-05

MOLE FRACTIONS

   C3     1.253-04  2.412-20  3.516-21  5.132-22  1.066-22  2.082-23  4.117-24  8.566-25  4.685-26  7.766-29
               5.788-32  1.398-37  0.000
   CO     3.390-01  2.354-01  1.962-01  1.586-01  1.310-01  1.058-01  8.467-02  6.754-02  4.353-02  1.545-02
               4.443-03  3.593-04  0.000
   H      3.339-03  2.185-02  1.716-02  1.288-02  9.982-03  7.577-03  5.727-03  4.354-03  2.615-03  8.558-04
               2.467-04  2.607-05  0.000
   N2     5.583-01  6.465-01  6.628-01  6.791-01  6.915-01  7.034-01  7.139-01  7.228-01  7.363-01  7.554-01
               7.667-01  7.761-01  7.791-01
   E-     4.674-13  4.926-08  5.420-08  5.082-08  4.450-08  3.680-08  2.940-08  2.310-08  1.419-08  4.367-09
               1.097-09  1.102-10  3.504-11
   C*     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
               0.000     0.000     0.000
   O2     4.379-16  6.315-03  1.367-02  2.386-02  3.362-02  4.454-02  5.568-02  6.647-02  8.573-02  1.222-01
               1.530-01  1.886-01  2.026-01
   C      2.314-06  8.286-10  3.994-10  1.757-10  8.591-11  3.969-11  1.809-11  8.356-12  1.962-12  7.716-14
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											2.711-15	3.555-16	0.000
CH	3.995-07	3.637-11	1.476-11	5.616-12	2.476-12	1.039-12	4.345-13	1.857-13	3.823-14	1.170-15	2.340-17	2.139-20	0.000
CHN	6.262-02	1.208-07	4.518-08	2.078-08	1.118-08	5.932-09	3.187-09	1.755-09	5.880-10	5.464-11	3.824-12	2.683-14	0.000
CHO	3.990-06	5.492-06	3.630-06	2.321-06	1.572-06	1.031-06	6.700-07	4.372-07	1.949-07	3.128-08	3.734-09	5.765-11	0.000
CH2	9.120-02	1.157-12	4.004-13	1.351-13	5.522-14	2.175-14	8.639-15	3.541-15	6.854-16	1.919-17	3.542-19	2.273-22	0.000
CH3	2.442-06	2.310-12	6.905-13	2.124-13	8.284-14	3.170-14	1.241-14	5.069-15	9.921-16	3.002-17	6.168-19	3.765-22	0.000
CH4	2.812-07	3.179-14	4.125-15	2.232-15	8.124-16	2.942-16	1.104-16	4.365-17	8.176-18	2.357-19	4.683-21	2.166-24	0.000
CN	3.773-04	1.324-08	6.799-09	3.359-09	1.852-09	9.845-10	5.212-10	2.799-10	8.764-11	6.620-12	3.590-13	2.078-15	0.000
CO2	1.540-07	3.434-02	4.437-02	5.273-02	5.793-02	6.171-02	6.388-02	6.460-02	6.300-02	5.165-02	3.518-02	1.074-02	0.000
C2	3.865-06	2.033-15	5.310-16	1.306-16	4.029-17	1.165-17	3.356-18	9.975-19	1.043-19	6.994-22	2.498-24	1.159-28	0.000
C2H	2.760-03	5.332-14	1.222-14	2.824-15	8.594-16	2.510-16	7.436-17	2.298-17	2.637-18	2.309-20	1.138-22	7.114-27	0.000
C2H2	8.549-03	1.369-14	2.703-15	5.667-16	1.637-16	4.616-17	1.340-17	4.097-18	4.696-19	4.326-21	2.310-23	1.322-27	0.000
C2N2	2.344-03	1.463-14	4.315-15	1.325-15	5.148-16	1.947-16	7.468-17	2.962-17	5.371-18	1.256-19	1.926-21	8.265-25	0.000
C3H	8.302-03	1.334-19	1.675-20	2.217-21	4.370-22	8.234-23	1.594-23	3.280-24	1.790-25	3.112-28	2.504-31	5.493-37	0.000
C3H2	8.176-05	5.580-22	5.832-23	6.516-24	1.130-24	1.877-25	3.229-26	5.955-27	2.681-28	3.169-31	1.685-34	1.000-30	0.000
C3H3	3.966-06	6.315-24	5.568-25	5.402-26	8.483-27	1.287-27	2.041-28	3.503-29	1.398-30	1.315-33	5.498-37	1.000-30	0.000
HN	2.897-07	4.977-06	3.882-06	2.833-06	2.124-06	1.545-06	1.114-06	8.063-07	4.391-07	1.137-07	2.495-08	1.678-09	0.000
HO	2.465-09	1.054-02	1.266-02	1.355-02	1.354-02	1.304-02	1.224-02	1.131-02	9.470-03	5.915-03	3.240-03	8.958-04	0.000
H2	1.415-02	9.482-03	6.393-03	4.315-03	3.147-03	2.282-03	1.669-03	1.241-03	7.265-04	2.359-04	6.866-05	5.864-06	0.000
H2N	6.831-08	2.109-07	1.396-07	8.957-08	6.162-08	4.159-08	2.812-08	1.926-08	9.613-09	2.145-09	4.049-10	1.698-11	0.000
H2O	4.151-02	1.068-02	1.113-02	1.096-02	1.056-02	1.000-02	9.375-03	8.744-03	7.592-03	5.426-03	3.530-03	1.030-03	0.000
N	4.723-07	4.000-05	3.691-05	3.089-05	2.544-05	2.016-05	1.567-05	1.211-05	7.354-06	2.323-06	6.264-07	7.401-08	2.589-08
NO	1.175-09	1.083-02	1.587-02	2.048-02	2.362-02	2.622-02	2.815-02	2.947-02	3.072-02	2.989-02	2.635-02	1.970-02	1.678-02
O	3.628-10	1.406-02	1.969-02	2.351-02	2.505-02	2.536-02	2.470-02	2.346-02	2.033-02	1.305-02	7.244-03	2.572-03	1.523-03
C4	8.386-07	6.803-28	5.253-29	4.090-30	5.105-31	5.881-32	6.901-33	8.669-34	1.866-35	3.984-39	1.000-30	1.000-30	0.000
C5	6.514-06	3.038-33	1.296-34	5.872-36	4.829-37	3.664-38	2.871-39	1.000-30	1.000-30	1.000-30	1.000-30	1.000-30	0.000
C+	1.008-13	1.107-17	3.885-18	1.158-18	3.981-19	1.251-19	3.846-20	1.206-20	1.374-21	1.099-23	5.003-26	5.540-30	0.000
N+	3.846-20	1.762-17	1.114-17	5.573-18	2.825-18	1.300-18	5.744-19	2.534-19	5.347-20	1.597-21	3.159-23	5.709-26	2.616-27
N2+	4.675-16	7.498-15	5.160-15	3.031-15	1.818-15	1.018-15	5.555-16	3.032-16	9.617-17	7.263-18	4.082-19	4.012-21	4.223-22
O2-	1.611-28	7.321-11	1.792-10	3.096-10	4.050-10	4.753-10	5.111-10	5.164-10	4.716-10	2.851-10	1.279-10	2.779-11	1.237-11
CO+	2.626-13	6.113-13	3.526-13	1.740-13	9.042-14	4.355-14	2.038-14	9.552-15	2.262-15	8.628-17			

		2.104-18	3.293-21	0.000						
NO+	1.034-13	4.983-08	5.517-08	5.209-08	4.589-08	3.820-08	3.071-08	2.428-08	1.510-08	4.794-09
		1.259-09	1.408-10	4.823-11						
O+	3.538-22	3.283-14	3.205-14	2.370-14	1.614-14	9.924-15	5.769-15	3.285-15	1.088-15	8.208-17
		4.275-18	3.467-20	3.277-21						
O2+	4.395-25	4.398-12	6.816-12	7.776-12	7.422-12	6.394-12	5.136-12	3.962-12	2.256-12	5.257-13
		8.277-14	4.631-15	1.070-15						
O-	7.631-22	5.009-10	8.034-10	9.762-10	9.940-10	9.228-10	8.022-10	6.694-10	4.416-10	1.420-10
		3.402-11	2.872-12	8.196-13						

CASE 1 - - - - - - - - - - - - STREAMWISE DIMENSION .16979+01 FEET - - - -24 OCT 69 15:38:13

ITERATED VALUES — DAMP, MAX.LIN ERROR, MAX.ERRORS IN CONSERVATION EQS.

ITS	TIME	ALPH	FPPW	DAMP	MAX.LIN ERROR		MOMENTUM		ENERGY		C3		CO		H	
1	6.599	8.294	3.7619	.4999	5.-07	5	-8.2+00	12	1.1+03	2	2.6-01	2	-7.7-02	2	5.1-03	0
2	12,384	8.462	3.8916	1,0000	2.-06	5	-4.0+00	12	5.3+02	2	1.3-01	2	-3.6-02	2	2.5-03	0
3	18,053	8.463	3.8845	1,0000	3.-06	5	7.9-02	2	1.2+01	13	3.6-03	13	-1.1-03	13	7.1-05	0
4	23,265	8.463	3.8886	1,0000	1.-06	15	1.0-03	2	-3.7-01	2	1.7-05	12	4.6-05	2	3.6-07	0
5	28,475	8.463	3.8886	1,0000	1.-06	15	-1.2-03	12	3.8-01	12	3.2-05	12	9.2-06	12	1.1-06	0
6	33,685	8.463	3.8886	1,0000	1.-06	15	1.4-03	12	-3.2-01	12	1.6-05	12	-1.1-04	12	-5.1-07	[illegible]
7	33,895	8.463	3.8886	1,0000	1.-06	15	-6.1-04	12	1.3-01	7	-7.7-06	12	2.8-05	12	9.7-07	0
8	44,105	8.463	3.8886	1,0000	2.-06	11	-7.8-05	12	-2.2-01	12	1.9-05	12	-8.0-06	12	-5.3-07	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL (BTU/SEC SQ FT)	TOT ENTH	RERAD	QCOND
8,463+00	1.433-02	1,000+00	2.229+00	7.418+03	1.613-01	3.892-02	1.541+02	1.077+02	0.000	3.575+02

WALL SHEAR (LB/SQ FT)	MASS FLUXES (LB/SEC SQ FT) MECH REM	PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
3,106+01	0.000	0.000	4.589-02	4.589-02	-7.539-04	-3.332-02	2.759-02	6.478-03

MOM TRANS COEFF. RHO*UE*CF/2	HEAT TRANS COEFF. RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
1,348-01	1.415-01	0,000	3.243-01	3.243-01	1.685-01	1.685-01	1.685-01	1.685-01

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
2,562-03	9.893-03	1,070-02	3.925-03	3.979+06	3.724-03	3.724-03	3.724-03	3.724-03

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0,000	0.000	-7,713-01	0.000	3.889+00	3,108+01	1.011+03	2.802+03	-1.020+04	1.011+03	4.760+03	2.520+11
3,167-04	2.031-01	-7,132-01	4.633-01	6.737-01	3.557+01	1.370+03	7.304+02	-2.583+03	1.134+03	5.887+03	2.266+11
5,317-04	3.385-01	-6,453-01	5.318-01	3.380-01	3.608+01	1.445+03	3.806+02	-6.961+02	1.134+03	5.847+03	2.273+11
9,534-04	6.094-01	-4,910-01	5.998-01	1.639-01	3.638+01	1.523+03	1.921+02	-1.997+02	1.128+03	5.783+03	2.286+11
1,574-03	1.016+00	-2,356-01	6.517-01	9.151-02	3.633+01	1.584+03	1.109+02	-6.692+01	1.118+03	5.717+03	2.299+11
2,567-03	1.693+00	2,234-01	7.003-01	5.214-02	3.590+01	1.644+03	6.562+01	-2.432+01	1.105+03	5.641+03	2.314+11
4,077-03	2.708+00	9,579-01	7.427-01	3.123-02	3.497+01	1.698+03	4.092+01	-9.065+00	1.092+03	5.562+03	2.331+11
6,025-03	4.062+00	1,989+00	7.780-01	2.097-02	3.358+01	1.745+03	2.864+01	-1.036+00	1.080+03	5.484+03	2.348+11
9,623-03	6.771+00	4,169+00	8.303-01	1.766-02	3.021+01	1.819+03	2.583+01	-1.439+00	1.062+03	5.338+03	2.379+11
1,663-02	1.185+01	8,586+00	9.042-01	1.145-02	2.233+01	1.932+03	1.853+01	-1.397+00	1.033+03	5.029+03	2.451+11
2,295-02	1.693+01	1,330+01	9.500-01	6.566-03	1.456+01	2.008+03	1.143+01	-8.436-01	1.016+03	4.713+03	2.532+11
3,461-02	2.708+01	2,320+01	9.907-01	1.452-03	3.897+00	2.080+03	2.864+00	-2.461-01	1.002+03	4.260+03	2.664+11
5,084-02	4.232+01	3,839+01	1.000+00	0.000	0.000	2.100+03	0,000	-1.299-01	1.001+03	4.033+03	2.737+11

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0,000	1.768-02	4,473-05	8.906-01	3.407-01	2.205-05	6.910-01	7.371-01	2.759+01	0.000	0.000
3,167-04	1.425-02	5,159-05	8.275-01	3.291-01	2.510-05	6.763-01	7.390-01	2.748+01	5.056+00	9.760-01
5,317-04	1.449-02	5,142-05	8.389-01	3.276-01	2.464-05	6.836-01	7.390-01	2.776+01	1.106+01	1.133+00

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 9.534-04  1.480-02  5.112-05  8.516-01  3.260-01  2.415-05  6.899-01  7.392-01  2.804+01  2.388+01  1.294+00
 1.574-03  1.508-02  5.079-05  8.625-01  3.246-01  2.375-05  6.941-01  7.394-01  2.826+01  4.339+01  1.421+00
 2.587-03  1.539-02  5.041-05  8.736-01  3.231-01  2.335-05  6.976-01  7.396-01  2.846+01  7.585+01  1.543+00
 4.077-03  1.571-02  5.000-05  8.841-01  3.217-01  2.297-05  7.003-01  7.399-01  2.863+01  1.239+02  1.653+00
 6.025-03  1.601-02  4.958-05  8.935-01  3.204-01  2.262-05  7.022-01  7.402-01  2.876+01  1.775+02  1.747+00
 9.823-03  1.655-02  4.878-05  9.089-01  3.198-01  2.213-05  7.048-01  7.407-01  2.895+01  1.897+02  1.892+00
 1.660-02  1.767-02  4.700-05  9.350-01  3.159-01  2.099-05  7.071-01  7.417-01  2.913+01  2.164+02  2.112+00
 2.295-02  1.885-02  4.507-05  9.566-01  3.121-01  1.988-05  7.076-01  7.424-01  2.912+01  2.462+02  2.265+00
 3.461-02  2.074-02  4.218-05  9.852-01  3.069-01  1.831-05  7.071-01  7.433-01  2.896+01  2.982+02  2.439+00
 5.084-02  2.182-02  4.070-05  9.999-01  3.042-01  1.752-05  7.066-01  7.438-01  2.885+01  3.300+02  2.508+00

                                     DISTANCE FROM WALL,FT
           0.000     3.167-04  5.317-04  9.534-04  1.574-03  2.587-03  4.077-03  6.025-03  9.823-03  1.660-02
                2.295-02  3.461-02  5.084-02

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

  C3       5.023-02 -4.637-02 -6.054-02 -7.465-02 -8.552-02 -9.583-02 -1.050-01 -1.128-01 -1.249-01 -1.434-01
                -1.563-01 -1.701-01 -1.764-01
          -8.118-01 -1.393-01 -7.004-02 -3.419-02 -1.929-02 -1.117-02 -6.849-03 -4.731-03 -4.211-03 -3.067-03
                -2.022-03 -6.924-04  0.000
           3.311+00  5.114-01  1.324-01  3.670-02  1.198-02  4.258-03  1.564-03  1.920-04  2.253-04  2.060-04
                 1.309-04  1.898-05  7.192-05
  CO       3.441-01  3.728-01  3.770-01  3.812-01  3.844-01  3.875-01  3.902-01  3.928-01  3.961-01  4.016-01
                 4.054-01  4.095-01  4.114-01
           2.411-01  4.138-02  2.081-02  1.016-02  5.729-03  3.319-03  2.034-03  1.405-03  1.251-03  9.111-04
                 6.005-04  2.057-04  0.000
          -9.834-01 -1.519-01 -3.932-02 -1.090-02 -3.559-03 -1.265-03 -4.646-04 -5.703-05 -6.691-05 -6.118-05
                -3.887-05 -5.638-06 -2.136-05
  H        4.475-03  2.568-03  2.288-03  2.009-03  1.795-03  1.591-03  1.411-03  1.256-03  1.017-03  6.516-04
                 3.965-04  1.244-04  0.000
          -1.603-02 -2.751-03 -1.383-03 -6.752-04 -3.809-04 -2.206-04 -1.353-04 -9.342-05 -8.316-05 -6.057-05
                -3.992-05 -1.367-05  0.000
           6.538-02  1.010-02  2.614-03  7.247-04  2.366-04  8.408-05  3.089-05  3.791-06  4.448-06  4.067-06
                 2.584-06  3.749-07  1.420-06
  N2       6.012-01  6.710-01  6.813-01  6.915-01  6.993-01  7.068-01  7.134-01  7.190-01  7.278-01  7.412-01
                 7.505-01  7.604-01  7.650-01
           5.867-01  1.007-01  5.062-02  2.471-02  1.394-02  8.075-03  4.950-03  3.419-03  3.043-03  2.217-03
                 1.461-03  5.004-04 -0.000
          -2.393+00 -3.696-01 -9.567-02 -2.652-02 -8.660-03 -3.077-03 -1.130-03 -1.388-04 -1.628-04 -1.488-04
                -9.458-05 -1.372-05 -5.198-05

MOLE FRACTIONS

  C3       1.386-04  7.857-21  1.407-21  2.344-22  5.194-23  1.056-23  2.128-24  4.464-25  2.454-26  3.775-29
                 2.251-32  3.038-38  0.000
  CO       3.389-01  2.216-01  1.870-01  1.530-01  1.273-01  1.036-01  8.322-02  6.661-02  4.316-02  1.535-02
                 4.343-03  3.432-04  0.000
  H        3.667-03  2.050-02  1.627-02  1.237-02  9.666-03  7.379-03  5.595-03  4.261-03  2.564-03  8.307-04
                 2.313-04  2.241-05  0.000
  N2       5.587-01  6.521-01  6.668-01  6.818-01  6.937-01  7.051-01  7.153-01  7.241-01  7.374-01  7.564-01
                 7.677-01  7.771-01  7.805-01
  E-       5.142-13  4.853-08  4.979-08  4.529-08  3.916-08  3.210-08  2.544-08  1.985-08  1.205-08  3.570-09
                 8.311-10  6.656-11  1.495-11
  C*       0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
                 0.000     0.000     0.000
  O2       3.864-16  8.602-03  1.591-02  2.564-02  3.493-02  4.534-02  5.604-02  6.641-02  8.498-02  1.205-01
                 1.513-01  1.876-01  2.042-01
  C        2.682-06  5.464-10  2.747-10  1.251-10  6.226-11  2.904-11  1.326-11  6.110-12  1.423-12  5.275-14
                 1.191-15  1.417-18  0.000
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CH	4.288-07	2.146-11	9.376-12	3.768-12	1.710-12	7.309-13	3.082-13	1.321-13	2.724-14	7.993-16	1.411-17	9.316-21	0.000
CHN	6.175-02	6.402-08	3.167-08	1.552-08	8.626-09	4.677-09	2.546-09	1.414-09	4.788-10	4.416-11	2.927-12	1.818-14	0.000
CHO	3.695-06	4.214-06	2.919-06	1.919-06	1.322-06	8.788-07	5.762-07	3.784-07	1.704-07	2.738-08	3.171-09	4.652-11	0.000
CH2	9.077-09	6.249-13	2.410-13	8.782-14	3.738-14	1.514-14	6.109-15	2.528-15	4.953-16	1.359-17	2.263-19	1.171-22	0.000
CH3	2.250-06	1.169-12	4.050-13	1.377-13	5.663-14	2.253-14	9.027-15	3.749-15	7.515-16	2.290-17	4.459-19	2.484-22	0.000
CH4	2.399-07	1.480-14	4.547-15	1.411-15	5.482-16	2.081-16	8.066-17	3.264-17	6.332-18	1.882-19	3.662-21	1.724-24	0.000
CN	4.017-04	8.813-09	4.788-09	2.460-09	1.383-09	7.436-10	3.954-10	2.124-10	6.635-11	4.820-12	2.357-13	1.033-15	0.000
CO2	1.328-07	3.802-02	4.671-02	5.429-02	5.925-02	6.302-02	6.534-02	6.628-02	6.512-02	5.448-02	3.813-02	1.291-02	0.000
C2	4.377-06	9.178-16	2.702-16	7.209-17	2.316-17	6.859-18	1.996-18	5.944-19	6.194-20	3.863-22	1.135-24	3.121-29	0.000
C2H	2.895-03	2.317-14	6.250-15	1.607-15	5.160-16	1.560-16	4.710-17	1.470-17	1.705-18	1.435-20	6.131-23	2.684-27	0.000
C2H2	8.346-03	5.550-15	1.341-15	3.199-16	9.871-17	2.910-17	8.676-18	2.700-18	3.166-19	2.880-21	1.387-23	6.325-28	0.000
C2N2	2.240-03	6.673-15	2.279-15	7.661-16	3.109-16	1.209-16	4.706-17	1.881-17	3.436-18	7.769-20	1.005-21	3.382-25	0.000
C3H	8.510-03	4.051-20	6.498-21	1.004-21	2.137-22	4.234-23	8.423-24	1.760-24	9.766-26	1.619-28	1.084-31	1.510-37	0.000
C3H2	7.766-05	1.486-22	2.039-23	2.711-24	5.133-25	9.043-26	1.609-26	3.029-27	1.398-28	1.597-31	7.155-35	1.000-30	0.000
C3H3	3.489-06	1.510-24	1.805-25	2.128-26	3.690-27	5.988-28	9.889-29	1.742-29	7.193-31	6.655-34	2.391-37	1.000-30	0.000
HN	2.833-07	4.159-06	3.255-06	2.399-06	1.811-06	1.324-06	9.561-07	6.921-07	3.767-07	9.583-08	1.999-08	1.177-09	0.000
HO	2.336-09	1.134-02	1.285-02	1.345-02	1.334-02	1.281-02	1.202-02	1.111-02	9.319-03	5.833-03	3.180-03	8.798-04	0.000
H2	1.439-02	8.239-03	5.826-03	4.074-03	3.032-03	2.232-03	1.651-03	1.238-03	7.342-04	2.419-04	7.038-05	6.180-06	0.000
H2N	6.385-08	1.600-07	1.099-07	7.274-08	5.097-08	3.487-08	2.379-08	1.640-08	8.265-09	1.848-09	3.403-10	1.366-11	0.000
H2O	3.644-08	1.085-02	1.112-02	1.097-02	1.062-02	1.013-02	9.571-03	8.994-03	7.922-03	5.841-03	3.951-03	1.329-03	0.000
N	5.145-07	3.708-05	3.322-05	2.751-05	2.255-05	1.780-05	1.376-05	1.058-05	6.356-06	1.936-06	4.853-07	4.636-08	1.179-08
NO	1.104-09	1.232-02	1.656-02	2.049-02	2.321-02	2.547-02	2.715-02	2.829-02	2.932-02	2.826-02	2.459-02	1.771-02	1.431-02
O	3.711-10	1.637-02	2.087-02	2.382-02	2.490-02	2.490-02	2.405-02	2.269-02	1.948-02	1.224-02	6.542-03	2.080-03	1.046-03
C4	9.068-07	1.457-28	1.484-29	1.378-30	1.876-31	2.281-32	2.747-33	3.490-34	7.569-36	1.000-30	1.000-30	1.000-30	0.000
C5	6.883-06	4.612-34	2.821-35	1.602-36	1.471-37	1.196-38	1.000-30	1.000-30	1.000-30	1.000-30	1.000-30	1.000-30	0.000
C+	1.259-13	5.921-18	2.174-18	6.754-19	2.371-19	7.519-20	2.307-20	7.175-21	8.021-22	5.772-24	2.068-26	1.173-30	0.000
N+	4.516-20	1.189-17	7.184-18	3.558-18	1.796-18	8.202-19	3.581-19	1.557-19	3.193-20	8.570-22	1.365-23	1.318-26	2.382-28
N2+	5.042-16	5.309-15	3.565-15	2.087-15	1.250-15	6.971-16	3.771-16	2.037-16	6.331-17	4.422-18	2.120-19	1.317-21	7.029-23
O2-	1.319-28	8.691-11	1.708-10	2.651-10	3.313-10	3.780-10	3.990-10	3.978-10	3.570-10	2.085-10	8.841-11	1.617-11	5.584-12
CO+	2.830-13	4.266-13	2.460-13	1.230-13	6.449-14	3.118-14	1.456-14	6.791-15	1.590-15	5.682-17	1.190-18	1.233-21	0.000

NO+	1.048-13	4.913-08	5.667-08	4.635-08	4.028-08	3.320-08	2.646-08	2.076-08	1.274-08	3.880-09	9.420-10	8.419-11	2.082-11
O+	3.901-22	2.868-14	2.523-14	1.788-14	1.196-14	7.248-15	4.152-15	2.330-15	7.521-16	5.211-17	2.294-18	1.147-20	5.301-22
O2+	4.180-25	4.714-12	6.225-12	6.594-12	6.097-12	5.141-12	4.063-12	3.092-12	1.723-12	3.789-13	5.808-14	2.204-15	3.247-16
O-	7.243-22	5.202-10	7.170-10	8.112-10	8.014-10	7.294-10	6.248-10	5.154-10	3.341-10	1.026-10	2.254-11	1.474-12	2.852-13

CASE 1 - - - - - - - - - - - - STREAMWISE DIMENSION .23646+01 FEET - - - -24 OCT 69 15:38:58

ITERATED VALUES

ITS	TIME	ALPH	FPPW	DAMP	MAX.LIN ERROR		MAX.ERRORS IN CONSERVATION EQS. MOMENTUM		ENERGY		C3		CO		H		
1	6.655	8.493	4.0490	.4999	1.-06	5	-7.8+00	12	1.0+03	12	-2.7-01	12	8.0-02	12	-5.3-03	0	
2	12.488	8.529	4.1967	1.0000	1.-06	5	-3.8+00	12	5.1+02	12	-1.4-01	12	4.0-02	12	-2.7-03	0	
3	18.150	8.532	4.1938	1.0000	9.-07	5	6.0-02	2	1.7+01	13	1.8-03	13	-5.4-04	13	3.6-05	0	
4	23.302	8.532	4.1938	1.0000	1.-06	15	1.0-03	12	4.9-01	8	-1.5-05	12	8.7-05	4	-2.2-07	0	
5	28.404	8.532	4.1938	1.0000	1.-06	15	-9.7-04	12	-5.2-01	12	2.2-05	12	1.1-04	12	-1.1-06	0	
6	33.508	8.532	4.1938	1.0000	3.-06	16	3.3-04	12	-6.3-02	12	-3.0-05	12	-5.5-05	12	2.1-07	0	
7	38.609	8.532	4.1938	1.0000	5.-07	15	-6.1-04	12	3.3-01	12	1.9-05	12	-1.3-04	12	1.3-07	0	
8	43.709	8.532	4.1938	1.0000	1.-06	15	1.1-03	12	-1.8-01	7	1.1-05	12	-4.7-05	7	1.5-07	0	
9	48.808	8.532	4.1938	1.0000	1.-06	15	-3.7-04	12	1.2-01	13	-3.5-06	10	2.0-06	12	-6.1-08	0	
10	53.907	8.532	4.1938	1.0000	5.-07	15	-1.1-03	12	7.9-02	12	2.9-05	12	-3.6-05	12	-4.3-07	0	
11	59.004	8.532	4.1938	1.0000	4.-06	15	1.2-03	7	-1.1-01	7	1.3-05	12	-8.3-05	12	5.1-07	0	
12	64.102	8.532	4.1938	1.0000	5.-06	16	1.2-04	12	1.3-01	12	-1.9-05	12	2.2-05	12	3.2-07	0	

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT.ENTH (BTU/SEC SQ FT)	RERAD	QCOND
8.552+00	1.838-02	1.000+00	1.818+00	7.602+03	2.273-01	2.915-02	1.241+02	8.909+01	0.000	2.758+02

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS	CHAR (LB/SEC SQ FT)	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
2.531+01	0.000	0.000	3.508-02	3.508-02	-5.780-04	-2.554-02	2.115-02	4.966-03

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
1.071-01	1.126-01	0.000	3.115-01	3.115-01	1.305-01	1.305-01	1.305-01	1.305-01

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	CARBON	NITROGEN	OXYGEN
3.297-03	1.398-02	1.509-02	5.230-03	3.566+06	5.209-03	5.209-03	5.209-03	5.209-03

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	-8.199-01	0.000	4.194+00	2.531+01	9.980+02	3.065+03	-1.156+04	9.980+02	4.760+03	2.055+11
4.305-04	2.046-01	-7.570-01	4.927-01	6.191-01	2.894+01	1.383+03	6.979+02	-2.426+03	1.103+03	5.802+03	1.861+11
7.186-04	3.413-01	-6.849-01	5.564-01	3.137-01	2.925+01	1.456+03	3.668+02	-6.584+02	1.099+03	5.757+03	1.869+11
1.284-03	6.143-01	-5.233-01	6.202-01	1.539-01	2.936+01	1.532+03	1.870+02	-1.918+02	1.087+03	5.692+03	1.879+11
2.115-03	1.024+00	-2.583-01	6.694-01	8.629-02	2.919+01	1.592+03	1.095+02	-6.491+01	1.075+03	5.626+03	1.890+11
3.474-03	1.706+00	2.158-01	7.156-01	4.922-02	2.868+01	1.651+03	6.419+01	-2.370+01	1.060+03	5.552+03	1.903+11
5.471-03	2.730+00	9.708-01	7.559-01	2.946-02	2.776+01	1.704+03	3.992+01	-9.110+00	1.045+03	5.473+03	1.916+11
8.083-03	4.095+00	2.027+00	7.893-01	1.949-02	2.648+01	1.750+03	2.748+01	-1.076+00	1.031+03	5.396+03	1.930+11
1.318-02	6.825+00	4.251+00	8.382-01	1.630-02	2.365+01	1.821+03	2.455+01	-1.349+00	1.010+03	5.253+03	1.956+11
2.227-02	1.194+01	8.730+00	9.070-01	1.060-02	1.755+01	1.929+03	1.764+01	-1.275+00	9.796+02	4.947+03	2.016+11
3.077-02	1.706+01	1.349+01	9.500-01	6.185-03	1.169+01	2.003+03	1.112+01	-7.831-01	9.611+02	4.627+03	2.084+11
4.633-02	2.730+01	2.346+01	9.893-01	1.502-03	3.479+00	2.076+03	3.100+00	-1.882-01	9.458+02	4.153+03	2.200+11
6.774-02	4.266+01	3.877+01	1.000+00	0.000	0.000	2.100+03	0.000	-2.155-01	9.457+02	3.868+03	2.280+11

DISTANCE FROM WALL	DENSITY, RHO	VISCOSITY, MU	RHO*MU /RHOE*MUE,	SPECIFIC HEAT	THERMAL COND (BTU	PRANDTL NUMBER	MODIFIED SCHMIDT	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER

(FT)	(LB/CU FT)	LB/SEC FT	C	(BTU/LB R)	/SEC FT R)		NUMBER			
0,000	1.440-02	4,473-05	8.761-01	3.401-01	2.207-05	6.892-01	7.372-01	2.754+01	0.000	0.000
4,305-04	1.184-02	5,112-05	8.236-01	3.282-01	2.471-05	6.791-01	7.390-01	2.760+01	5.964+00	1.076+00
7,186-04	1.205-02	5,092-05	8.344-01	3.268-01	2.428-05	6.854-01	7.391-01	2.786+01	1.270+01	1.228+00
1,284-03	1.230-02	5,061-05	8.468-01	3.253-01	2.382-05	6.910-01	7.392-01	2.813+01	2.685+01	1.386+00
2,115-03	1.253-02	5,028-05	8.573-01	3.240-01	2.344-05	6.949-01	7.395-01	2.833+01	4.825+01	1.511+00
3,474-03	1.279-02	4,990-05	8.651-01	3.226-01	2.306-05	6.981-01	7.397-01	2.853+01	8.371+01	1.632+00
5,471-03	1.305-02	4,949-05	8.784-01	3.212-01	2.269-05	7.006-01	7.400-01	2.870+01	1.360+02	1.741+00
8,083-03	1.330-02	4,907-05	8.877-01	3.216-01	2.246-05	7.026-01	7.403-01	2.883+01	1.964+02	1.835+00
1,318-02	1.374-02	4,828-05	9.028-01	3.196-01	2.189-05	7.049-01	7.408-01	2.901+01	2.098+02	1.976+00
2,227-02	1.468-02	4,650-05	9.287-01	3.158-01	2.076-05	7.071-01	7.417-01	2.918+01	2.394+02	2.192+00
3,077-02	1.569-02	4,454-05	9.506-01	3.120-01	1.964-05	7.076-01	7.424-01	2.917+01	2.734+02	2.344+00
4,633-02	1.738-02	4,149-05	9.808-01	3.066-01	1.799-05	7.070-01	7.434-01	2.900+01	3.353+02	2.526+00
6,774-02	1.857-02	3,959-05	9.999-01	3.031-01	1.699-05	7.065-01	7.439-01	2.885+01	3.828+02	2.619+00

DISTANCE FROM WALL,FT

0.000 4,305-04 7.186-04 1.284-03 2.115-03 3.474-03 5.471-03 8.083-03 1.318-02 2.227-02
3.077-02 4.633-02 6.774-02

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

C3 4.785-02 -5,134-02 -6.410-02 -7.699-02 -8.704-02 -9.667-02 -1.053-01 -1.127-01 -1.242-01 -1.419-01
-1.546-01 -1.686-01 -1.764-01
-8.449-01 -1,240-01 -6.310-02 -3.128-02 -1.782-02 -1.041-02 -6.432-03 -4.425-03 -3.977-03 -2.963-03
-2.003-03 -7.313-04 0.000
3.521+00 4,458-01 1.166-01 3.287-02 1.085-02 3.883-03 1.471-03 1.641-04 1.980-04 1.875-04
1.243-04 -7.207-06 1.025-04

CO 3.448-01 3,743-01 3.781-01 3.819-01 3.849-01 3.877-01 3.903-01 3.925-01 3.959-01 4.012-01
4.049-01 4.091-01 4.114-01
2.510-01 3,682-02 1.874-02 9.290-03 5.292-03 3.092-03 1.911-03 1.314-03 1.181-03 8.801-04
5.951-04 2.172-04 0.000
-1.046+00 -1,324-01 -3.463-02 -9.764-03 -3.224-03 -1.154-03 -4.369-04 -4.874-05 -5.882-05 -5.568-05
-3.691-05 2.142-06 -3.043-05

H 4.428-03 2,470-03 2.218-03 1.963-03 1.765-03 1.575-03 1.404-03 1.258-03 1.032-03 6.809-04
4.299-04 1.534-04 0.000
-1.668-02 -2,448-03 -1.246-03 -6.176-04 -3.518-04 -2.055-04 -1.270-04 -8.737-05 -7.853-05 -5.851-05
-3.956-05 -1.444-05 0.000
6.953-02 8,802-03 2.302-03 6.491-04 2.143-04 7.669-05 2.904-05 3.240-06 3.910-06 3.702-06
2,454-06 -1.423-07 2.023-06

N2 6.029-01 6,746-01 6.838-01 6.931-01 7.004-01 7.074-01 7.136-01 7.190-01 7.272-01 7.401-01
7.493-01 7.594-01 7.650-01
6.106-01 8,958-02 4.561-02 2.260-02 1.288-02 7.522-03 4.649-03 3.198-03 2.874-03 2.141-03
1.448-03 5.285-04 -0.000
-2.545+00 -3,222-01 -8.425-02 -2.376-02 -7.844-03 -2.807-03 -1.063-03 -1.186-04 -1.431-04 -1.355-04
-8.980-05 5.208-06 -7.404-05

MOLE FRACTIONS

C3 1.385-04 2,230-21 4.573-22 8.317-23 1.926-23 4.023-24 8.214-25 1.736-25 9.696-27 1.437-29
7,126-33 5.674-39 0.000

CO 3.390-01 2,087-01 1.773-01 1.461-01 1.221-01 9.965-02 8.027-02 6.439-02 4.196-02 1.500-02
4.211-03 3.312-04 0.000

H 4.192-03 1,885-02 1.507-02 1.155-02 9.070-03 6.950-03 5.281-03 4.028-03 2.434-03 7.863-04
2.128-04 1.899-05 0.000

N2 5.607-01 6,581-01 6.717-01 6.858-01 6.971-01 7.081-01 7.180-01 7.264-01 7.393-01 7.577-01
7,688-01 7.781-01 7.820-01

E- 5.777-13 4,305-08 4.218-08 3.742-08 3.195-08 2.592-08 2.037-08 1.578-08 9.486-09 2.726-09
5,921-10 3.781-11 5.042-12

C* 0.000 0,000 0.000 0.000 0.000 0,000 0.000 0.000 0.000 0.000
0.000 0.000 0.000

O2	3.615-14	1.090-02	1.817-02	2.757-02	3.647-02	4.644-02	5.668-02	6.660-02	8.431-02	1.186-01	1.488-01	1.856-01	2.057-01
C	3.071-06	3.214-10	1.661-10	7.723-11	3.879-11	1.817-11	8.289-12	3.810-12	8.862-13	3.156-14	6.290-16	5.125-19	0.000
CH	4.576-07	1.151-11	5.277-12	2.197-12	1.016-12	4.392-13	1.861-13	8.005-14	1.663-14	4.775-16	7.598-18	3.703-21	0.000
CHN	5.964-02	3.977-08	2.099-08	1.074-08	6.112-09	3.369-09	1.853-09	1.037-09	3.565-10	3.307-11	2.107-12	1.187-14	0.000
CHO	3.445-06	3.209-06	2.260-06	1.512-06	1.053-06	7.059-07	4.656-07	3.075-07	1.401-07	2.275-08	2.586-09	3.688-11	0.000
CH2	9.034-08	3.164-13	1.311-13	5.029-14	2.202-14	9.098-15	3.717-15	1.553-15	3.099-16	8.511-18	1.329-19	5.606-23	0.000
CH3	2.087-06	5.801-13	2.217-13	8.072-14	3.452-14	1.412-14	5.781-15	2.440-15	5.041-16	1.579-17	2.976-19	1.564-22	0.000
CH4	2.075-07	6.994-15	2.428-15	8.207-16	3.349-16	1.320-16	5.260-17	2.178-17	4.401-18	1.377-19	2.682-21	1.336-24	0.000
CN	4.161-04	5.425-09	3.058-09	1.611-09	9.164-10	4.962-10	2.643-10	1.420-10	4.447-11	3.153-12	1.413-13	4.772-16	0.000
CO2	1.161-07	4.216-02	5.001-02	5.710-02	6.188-02	6.562-02	6.801-02	6.905-02	6.815-02	5.810-02	4.192-02	1.604-02	0.000
C2	4.682-06	3.598-16	1.146-16	3.222-17	1.062-17	3.194-18	9.338-19	2.786-19	2.921-20	1.745-22	4.346-25	7.334-30	0.000
C2H	2.886-03	9.289-15	2.790-15	7.706-16	2.568-16	7.962-17	2.437-17	7.682-18	9.079-19	7.549-21	2.878-23	9.190-28	0.000
C2H2	7.758-03	2.166-15	5.977-16	1.559-16	5.047-17	1.540-17	4.690-18	1.484-18	1.794-19	1.656-21	7.409-24	2.821-28	0.000
C2N2	1.961-03	2.828-15	1.063-15	3.799-16	1.590-16	6.309-17	2.481-17	9.987-18	1.849-18	4.128-20	4.860-22	1.264-25	0.000
C3H	7.926-03	1.119-20	2.108-21	3.617-22	8.133-23	1.671-23	3.394-24	7.196-25	4.105-26	6.730-29	3.899-32	3.666-38	0.000
C3H2	6.742-05	3.621-23	5.946-24	8.908-25	1.796-25	3.305-26	6.038-27	1.159-27	5.553-29	6.373-32	2.508-35	1.000-30	0.000
C3H3	2.824-06	3.375-25	4.930-26	6.643-27	1.238-27	2.115-28	3.609-29	6.520-30	2.819-31	2.669-34	8.609-38	1.000-30	0.000
HN	2.929-07	3.286-06	2.577-06	1.909-06	1.446-06	1.059-06	7.656-07	5.544-07	3.024-07	7.618-08	1.522-08	7.875-10	0.000
HO	2.332-09	1.179-02	1.287-02	1.322-02	1.301-02	1.245-02	1.165-02	1.077-02	9.046-03	5.685-03	3.093-03	8.600-04	0.000
H2	1.534-02	7.294-03	5.325-03	3.816-03	2.883-03	2.149-03	1.605-03	1.213-03	7.303-04	2.457-04	7.196-05	6.561-06	0.000
H2N	6.156-08	1.178-07	8.298-08	5.606-08	3.979-08	2.750-08	1.890-08	1.311-08	6.688-09	1.512-09	2.739-10	1.061-11	0.000
H2O	3.391-08	1.120-02	1.136-02	1.119-02	1.088-02	1.043-02	9.917-03	9.382-03	8.375-03	6.375-03	4.495-03	1.761-03	0.000
N	5.707-07	3.176-05	2.792-05	2.288-05	1.865-05	1.463-05	1.125-05	8.599-06	5.130-06	1.518-06	3.557-07	2.743-08	4.326-09
NO	1.070-09	1.327-02	1.686-02	2.019-02	2.251-02	2.443-02	2.585-02	2.678-02	2.756-02	2.630-02	2.259-02	1.567-02	1.168-02
O	3.975-10	1.775-02	2.128-02	2.345-02	2.409-02	2.379-02	2.277-02	2.133-02	1.815-02	1.118-02	5.766-03	1.641-03	6.457-04
C4	8.461-07	2.586-29	3.158-30	3.302-31	4.766-32	6.013-33	7.370-34	9.464-35	2.098-36	1.000-30	1.000-30	1.000-30	0.000
C5	5.999-06	5.768-35	4.468-36	2.955-37	2.929-38	1.000-30	1.000-30	1.000-30	1.000-30	1.000-30	1.000-30	1.000-30	0.000
C+	1.574-13	2.579-18	9.760-19	3.104-19	1.100-19	3.496-20	1.067-20	3.296-21	3.653-22	2.438-24	7.062-27	2.082-31	0.000
N+	5.467-20	6.352-18	3.729-18	1.822-18	9.112-19	4.116-19	1.772-19	7.603-20	1.530-20	3.776-22	4.929-24	2.534-27	1.131-29
N2+	5.522-16	3.156-15	2.087-15	1.214-15	7.229-16	4.004-16	2.145-16	1.148-16	3.520-17	2.312-18	9.581-20	3.752-22	7.215-24

O2-	1.130-28	8.591-11	1.459-10	2.086-10	2.503-10	2.775-10	2.871-10	2.821-10	2.483-10	1.403-10	5.634-11	8.684-12	2.036-12
CO+	3.089-13	2.578-13	1.486-13	7.466-14	3.919-14	1.892-14	8.794-15	4.080-15	9.501-16	3.243-17	5.950-19	4.140-22	0.000
NO+	1.108-13	4.358-08	4.289-08	3.824-08	3.278-08	2.672-08	2.109-08	1.641-08	9.962-09	2.933-09	6.620-10	4.719-11	7.152-12
O+	4.559-22	2.038-14	1.674-14	1.144-14	7.502-15	4.469-15	2.519-15	1.394-15	4.413-16	2.854-17	1.077-18	3.306-21	5.218-23
O2+	4.268-25	4.216-12	5.009-12	5.001-12	4.487-12	3.700-12	2.872-12	2.155-12	1.178-12	2.465-13	3.419-14	9.511-16	7.137-17
O-	7.108-22	4.569-10	5.696-10	6.092-10	5.849-10	5.214-10	4.395-10	3.580-10	2.283-10	6.728-11	1.364-11	6.897-13	7.439-14

3. SAMPLE CASE 3 - ABLATING REENTRY VEHICLE SHAPE

Sample problem 3 is typical of the type of problem the aerospace thermodynamicist must solve quite often. At a discrete time during the trajectory, the nonsimilar solution for the boundary layer flow field over a sphere-cone body composed of a nose tip, window, and heat shield material is desired. For this problem, the following conditions were chosen:

$$P_o = 120.5 \text{ atmospheres}$$

$$H_o = 5520 \text{ Btu/lb}$$

$$R_N = 0.5 \text{ inches}$$

$$\theta_{cone} = 7.5^o$$

A total of 29 body stations were required to describe the body static pressure distribution accurately. A great deal of care is used in selecting these points since cubic curve fits are used to determine pressure gradients. Large gaps in spacing or large changes in pressure between body stations can lead to very poor curve fits.

Of these 29 body stations, the first seven were assumed to include a graphite nose tip, the next four spanned a boron nitride window material, and the remaining 18 covered the carbon phenolic heat shield region. Once the body stations of interest had been selected, the automatic radius calculating scheme for card group 5 could be used, therefore only the radii at the nose, tangent point, and final body station were specified, with a minus sign on the nose radius at station 1. The rest of the input for this problem is similar to the previous sample problem. Boron was added to the list of elements, and the virgin material elemental makeups for the 3 materials were assigned to the char category for the steady-state ablation approximation. Sixty thermochemical species were included for this B-C-H-O-N-e^- system.

a. Input Cards for Sample Case Number 3

```
1020402040020200000OTURBULENT B.L.  3 MATERIALS, C*,BN,C6H60

 5         1111111222233333333333333333
 1
-1.
29
0.0        .00417364 .00838991 .0126955  .0171465  .0218166  -.0268125 -.0323082
.0386372   .0466570  -.059975  -.0627266 .070      .075      .0775     .0875
 .1        .125      .150      .200      .300      .500      .700      1.0
1.5        2.0       3.0       4.0       5.0164
13
0.0        .024      .04       .072      .120      .20       .32        .48
.80        1.4       2.0       3.2       5.0
11   .95
 7.5       .041667
-.0416667
                     .041308
      (1 blank card)
                                         .687499
1.0       0.0             1.0      -4300.         1.0      -358.6
C*        BN*      C*
120.5
5520.

.44        11.283    .019      .75       .75       250.
3000.
  6  .431  23.4      32.       3.467      106.7
  1HYDROGEN     1.00797                                                 -0.0209
  5BORON        10.811                                        1.
  6CARBON       12.011                          1.                      -0.9236
  7NITROGEN     14.008  -.765                                 1.
  8OXYGEN       16.000  -.235                                           -0.0554
 99ELECTRON     0.00055
  3  6  0  0  0  0  0  0  0  0  0  0  0  0JANAF 12/60                    C3
 189670+6 366220+5 146441+2 622536-4-168227+7 798410+2  500. 3000.1    0.C3
 189670+6 366220+5 144782+2 792232-4-646877+6 798410+2 3000. 5000.1    0.C3
  1  6  0  0  0  0  0  0  0  0  0  0  0  0JANAF 03/61                    C*
 000000-0 144120+5 586075+1 953976-4-766621+6 121290+2  500. 3000.2 100.C*
 000000-0 144120+5 485134+1 291605-3 3[illegible]+7 121290+2 3000. 5000.2 100.C*
  1  6  1  8  0  0  0  0  0  0  0  0  0  0JANAF 03/61                    CO
-264170+5 223570+5 865040+1 11[illegible]211+6 653700+2  500. 3000.1    0.CO
-264170+5 223570+5 115496+2-[illegible]-3 1[illegible]3+8 653700+2 3000. 5000.1    0.CO
  1  1  0  0  0  0  0  0  0  0  0  0  0  0JANAF 12/60                    H
 521020+5 134230+5 480223+1 555489-4 173095+6 388620+2  500. 3000.1    0.H
 521020+5 134230+5 308752+1 315625-3 929744+7 388620+2 3000. 5000.1    0.H
  1  5  1  7  0  0  0  0  0  0  0  0  0  0JANAF 09/63                    BN
 152000+6 244620+5 880110+1 108795-3-112446+6 699360+2  500. 3000.1    0.BN
 152000+6 244620+5 880750+1 998189-4 723668+5 699360+2 3000. 5000.1    0.BN
  1  5  1  7                                JANAF 9/63                   BN*
-595100+5 291896+5 119161+2 239906-4-891069+6 257049+2  500. 2500.2   10.BN*
-595100+5 290739+5 117157+2 257181-5-240029+6 256618+2 2500. 5000.2   10.BN*
```

```
 2  7  0  0  0  0   0  0  0   0  0  0  0  0JANAF 03/61                   N2
000000-0 221650+5 862699+1 116090-3-103715+7 637650+2  500. 3000.1    0.N2
000000-0 221650+5 984175+1-116232-3-612728+7 637650+2 3000. 5000.1    0.N2
 1  6  0  0  0  0   0  0  0   0  0  0  0  0JANAF 03/61                   C
170886+6 135500+5 444433+1 228125-3 409830+6 492870+2  500. 3000.1    0.C
170886+6 135500+5 412212+1 261908-3 262886+7 492870+2 3000. 5000.1    0.C
 1  1  1  6  0  0   0  0  0   0  0  0  0  0JANAF 03/61                   CH
142006+6 221300+5 826079+1 302211-3-100184+7 616120+2  500. 3000.1    0.CH
142006+6 221300+5 707091+1 463281-3 552860+7 616120+2 3000. 5000.1    0.CH
 1  1  1  6  1  7   0  0  0   0  0  0  0  0JANAF 03/61                   CHN
312000+5 355930+5 137023+2 552243-3-228955+7 758620+2  500. 3000.1    0.CHN
312000+5 355930+5 178895+2-295052-3-183671+8 758620+2 3000. 5000.1    0.CHN
 1  1  1  6  1  8   0  0  0   0  0  0  0  0JANAF 03/61                   CHO
-290000+4 323670+5 128033+2 300638-3-201721+7 789830+2  500. 3000.1   0.CHO
-290000+4 323670+5 103028+2 633312-3 121615+8 789830+2 3000. 5000.1   0.CHO
 2  1  1  6  0  0   0  0  0   0  0  0  0  0JANAF 12/62                   CH2
950000+5 329960+5 132894+2 413822-3-290273+7 684940+2  500. 3000.1    0.CH2
950000+5 329960+5 140728+2 132150-3-239493+7 684940+2 3000. 5000.1    0.CH2
 3  1  1  6  0  0   0  0  0   0  0  0  0  0JANAF 12/62                   CH3
319400+5 434190+5 182763+2 401025-3-461203+7 786040+2  500. 3000.1    0.CH3
319400+5 434190+5 204899+2-108028-3-114692+8 786040+2 3000. 5000.1    0.CH3
 4  1  1  6  0  0   0  0  0   0  0  0  0  0JANAF 03/61                   CH4
-178950+5 530790+5 230948+2 677896-3-755061+7 825970+2  500. 3000.1   0.CH4
-178950+5 530790+5 236053+2 374323-3-368234+7 825970+2 3000. 5000.1   0.CH4
 1  6  1  7  0  0   0  0  0   0  0  0  0  0JANAF 12/62                   CN
109000+6 232490+5 655906+1 115326-2 479517+6 669760+2  500. 3000.1    0.CN
109000+6 232490+5 988013+1 313855-3-649453+7 669760+2 3000. 5000.1    0.CN
 1  6  2  8  0  0   0  0  0   0  0  0  0  0JANAF 03/61                   CO2
-940540+5 365350+5 144559+2 210386-3-182392+7 798480+2  500. 3000.1   0.CO2
-940540+5 365350+5 156451+2-381561-4-602768+7 798480+2 3000. 5000.1   0.CO2
 2  6  0  0  0  0   0  0  0   0  0  0  0  0JANAF 9/61                    C2
198999+6 246990+5 776612+1 696081-3 185649+6 685519+2  500. 3000.1    0.C2
198999+6 246990+5 104162+2 566841-4-640205+7 685519+2 3000. 5000.1    0.C2
 1  1  2  6  0  0   0  0  0   0  0  0  0  0DUFF BAUER 6/61              C2H
117395+6 349620+5 134210+2 469100-3-187509+7 781140+2  500. 3000.1    0.C2H
117395+6 349620+5 148516+2 109402-3-503862+7 781140+2 3000. 5000.1    0.C2H
 2  1  2  6  0  0   0  0  0   0  0  0  0  0JANAF 03/61                   C2H2
541900+5 482570+5 189960+2 769044-3-409039+7 849690+2  500. 3000.1    0.C2H2
541900+5 482570+5 203952+2 389062-3-645297+7 849690+2 3000. 5000.1    0.C2H2
 2  6  2  7  0  0   0  0  0   0  0  0  0  0JANAF 3/61                    C2N2
738699+5 511070+5 188740+2 559856-3-896873+6 985479+2  500. 3000.1    0.C2N2
738699+5 511070+5 208204+2 630229-5-346865+7 985479+2 3000. 5000.1    0.C2N2
 1  1  3  6  0  0   0  0  0   0  0  0  0  0DUFF BAUER 6/61              C3H
127703+6 489620+5 194464+2 508379-3-311933+7 928820+2  500. 3000.1    0.C3H
127703+6 489620+5 199582+2 245687-3-632514+6 928820+2 3000. 5000.1    0.C3H
 2  1  3  6  0  0   0  0  0   0  0  0  0  0DUFF BAUER 6/61              C3H2
106522+6 635170+5 247444+2 992918-3-437596+7 104666+3  500. 3000.1    0.C3H2
106522+6 635170+5 266623+2 364767-3-467730+7 104666+3 3000. 5000.1    0.C3H2
 1  1  1  7  0  0   0  0  0   0  0  0  0  0JANAF 12/60                   HN
792000+5 217660+5 823133+1 281555-3-126896+7 609290+2  500. 3000.1    0.HN
792000+5 217660+5 765457+1 359853-3 180778+7 609290+2 3000. 5000.1    0.HN
 1  1  1  8  0  0   0  0  0   0  0  0  0  0JANAF 12/60                   HO
933000+4 214040+5 773193+1 394386-3-973561+6 613820+2  500. 3000.1    0.HO
```

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 933000+4 214040+5 965144+1-443528-4-686115+7 613820+2 3000. 5000.1   0.HO
  2  1  0  0  0  0  0  0  0  0  0  0  0  OJANAF 03/61                  H2
 000000-0 212100+5 711963+1 621950-3-712694+6 484650+2  500. 3000.1   0.H2
 000000-0 212100+5 681794+1 589854-3 265106+7 484650+2 3000. 5000.1   0.H2
  2  1  1  7  0  0  0  0  0  0  0  0  0  OJANAF 12/65                  H2N
 400999+5 305799+5 975862+1 114401-2-518970+6 701580+2  500. 3000.1   0.H2N
 400999+5 305799+5 137419+2 229493-4-610024+7 701580+2 3000. 5000.1   0.H2N
  2  1  1  8  0  0  0  0  0  0  0  0  0  OJANAF 03/61                  H20
-577980+5 302010+5 112254+2 811397-3-260800+7 684210+2  500. 3000.1   0.H20
-577980+5 302010+5 157278+2-191548-3-173599+8 684210+2 3000. 5000.1   0.H20
  1  7  0  0  0  0  0  0  0  0  0  0  0  OJANAF 03/61                  N
 112965+6 134370+5 486944+1 383516-4 958460+5 480900+2  500. 3000.1   0.N
 112965+6 134370+5 428957+1 240844-3-417273+6 480900+2 3000. 5000.1   0.N
  1  7  1  8  0  0  0  0  0  0  0  0  0  OJANAF 06/63                  NO
 215800+5 227000+5 877623+1 899031-4-789656+6 688490+2  500. 3000.1   0.NO
 215800+5 227000+5 916260+1 657885-5-212519+7 688490+2 3000. 5000.1   0.NO
  1  8  0  0  0  0  0  0  0  0  0  0  0  OJANAF 06/62                  O
 595590+5 135220+5 497228+1 380768-5 154749+5 500960+2  500. 3000.1   0.O
 595590+5 135220+5 657489+1-224268-3-891782+7 500960+2 3000. 5000.1   0.O
  2  8  0  0  0  0  0  0  0  0  0  0  0  OJANAF 03/61                  O2
 000000-0 234460+5 804370+1 510872-3-152718+6 679730+2  500. 3000.1   0.O2
 000000-0 234460+5 103071+2 290991-4-783079+7 679730+2 3000. 5000.1   0.O2
  4  6  0  0  0  0  0  0  0  0  0  0  0  OJANAF 12/60                  C4
 242321+6 511230+5 205903+2 623436-4-257703+7 986760+2  500. 3000.1   0.C4
 242321+6 511230+5 210714+2-434895-4-404939+7 986760+2 3000. 5000.1   0.C4
  5  6  0  0  0  0  0  0  0  0  0  0  0  OJANAF 12/60                  C5
 242374+6 656230+5 264706+2 806528-4-337125+7 111641+3  500. 3000.1   0.C5
 242374+6 656230+5 271156+2-580271-4-543183+7 111641+3 3000. 5000.1   0.C5
  1  5  0  0  0  0  0  0  0  0  0  0  0  OJANAF 12/60                  B
 132618+6 134240+5 506024+1-307108-4-985641+5 481210+2  500. 3000.1   0.B
 132618+6 134240+5 507458+1-121838-4-726353+6 481210+2 3000. 5000.1   0.B
  1  5  1  6  0  0  0  0  0  0  0  0  0  OJANAF 06/63                  CB
 198000+6 233870+5 887101+1 987600-4-461666+6 689650+2  500. 3000.1   0.CB
 198000+6 233870+5 864500+1 134780-3 599853+6 689650+2 3000. 5000.1   0.CB
  1  1  1  5  0  0  0  0  0  0  0  0  0  OJANAF 03/63                  BH
 105630+6 226370+5 871723+1 193099-3-113880+7 593240+2  500. 3000.1   0.BH
 105630+6 226370+5 962344+1 127652-4-442568+7 593240+2 3000. 5000.1   0.BH
  1  1  1  5  1  8  0  0  0  0  0  0  0  OJANAF 12/60                  BHO
-471270+5 356030+5 142974+2 167620-3-201136+7 764730+2  500. 3000.1   0.BHO
-471270+5 356030+5 112392+2 644865-3 134967+8 764730+2 3000. 5000.1   0.BHO
  1  1  1  5  2  8  0  0  0  0  0  0  0  OJANAF 06/63                  BHO2
-134100+6 456640+5 182280+2 425108-3-301044+7 924900+2  500. 3000.1   0.BHO2
-134100+6 456640+5 168746+2 521159-3 699798+7 924900+2 3000. 5000.1   0.BHO2
  2  1  1  5  0  0  0  0  0  0  0  0  0  OJANAF 12/60                  BH2
 660000+5 327480+5 131819+2 199298-3-211346+7 728220+2  500. 3000.1   0.BH2
 660000+5 327480+5 133411+2 907704-4-580069+6 728220+2 3000. 5000.1   0.BH2
  2  1  1  5  2  8  0  0  0  0  0  0  0  OJANAF 12/60                  BH202
-450000+5 597060+5 246307+2 263481-3-476319+7 109074+3  500. 3000.1   0.BH202
-450000+5 597060+5 246015+2 206036-3-244306+7 109074+3 3000. 5000.1   0.BH202
  3  1  1  5  0  0  0  0  0  0  0  0  0  OJANAF 12/60                  BH3
 180000+5 424590+5 179007+2 501613-3-495709+7 763790+2  500. 3000.1   0.BH3
 180000+5 424590+5 186890+2 214061-3-464131+7 763790+2 3000. 5000.1   0.BH3
  3  1  1  5  3  8  0  0  0  0  0  0  0  OJANAF 03/61                  BH303
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-238600+6 860730+5 356846+2 478490-3-720419+7 131808+3  500. 3000.1    0.BH303
-238600+6 860730+5 377529+2-105305-4-127237+8 131808+3 3000. 5000.1    0.BH303
  1  5  1  8  0  0  0  0  0  0  0  0  0  0JANAF 06/62                     BO
 574400+4 226450+5 862197+1 136981-3-631704+6 670240+2  500. 3000.1    0.BO
 574400+4 226450+5 803486+1 210252-3 264653+7 670240+2 3000. 5000.1    0.BO
  1  5  2  8  0  0  0  0  0  0  0  0  0  0JANAF 06/63                     BO2
-726000+5 379300+5 148552+2 119400-4-999435+6 856360+2  500. 3000.1    0.BO2
-726000+5 379300+5 118268+2 637770-3 935859+7 856360+2 3000. 5000.1    0.BO2
  2  5  0  0  0  0  0  0  0  0  0  0  0  0JANAF 12/60                     B2
 199300+6 238090+5 891017+1 112093-3-321955+6 678510+2  500. 3000.1    0.B2
 199300+6 238090+5 724425+1 412560-3 687918+7 678510+2 3000. 5000.1    0.B2
  4  1  2  5  4  8  0  0  0  0  0  0  0  0JANAF 03/66                     B2H4O4
-306999+6 125740+6 450887+2 266027-2-332605+7 179643+3  500. 3000.1    0.B2H4O4
-306999+6 125740+6 543119+2 450391-4-157235+8 179643+3 3000. 5000.1    0.B2H4O4
  6  1  2  5  0  0  0  0  0  0  0  0  0  0JANAF 12/64                     B2H6
 979999+4 957649+5 341573+2 274368-2-380166+7 125539+3  500. 3000.1    0.B2H6
 979999+4 957649+5 435286+2 258895-4-147630+8 125539+3 3000. 5000.1    0.B2H6
  2  5  2  8  0  0  0  0  0  0  0  0  0  0JANAF 03/61                     B2O2
-111600+6 515500+5 207885+2 370455-5-251331+7 983970+2  500. 3000.1    0.B2O2
-111600+6 515500+5 196641+2 203148-3 284908+7 983970+2 3000. 5000.1    0.B2O2
  2  5  3  8  0  0  0  0  0  0  0  0  0  0JANAF 03/61                     B2O3
-210100+6 615070+5 257777+2-153675-4-427514+7 111710+3  500. 3000.1    0.B2O3
-210100+6 615070+5 239286+2 345774-3 329402+7 111710+3 3000. 5000.1    0.B2O3
  1 99  0  0  0  0  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61          E-
         +149010+5+498851+1-272800-5-135900+6+164558+22000. 10000.1       E-
         +149010+5+498851+1-272800-5-135900+6+164558+22000. 10000.1       E-
  1  6 -1 99  0  0  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61          C+
+428985+6+150120+5+489657+1+180700-4+340000+5+484232+22000. 10000.1       C+
+428985+6+150120+5+489657+1+180700-4+340000+5+484232+22000. 10000.1       C+
  1  7 -1 99  0  0  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61          N+
+446641+6+151310+5+501751+1+617100-4-184100+7+496847+22000. 10000.1       N+
+446641+6+151310+5+501751+1+617100-4-184100+7+496847+22000. 10000.1       N+
  2  7 -1 99  0  0  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61          N2+
+357258+6+251470+5+136508+2-327940-3-225630+8+656601+22000. 10000.1       N2+
+357258+6+251470+5+136508+2-327940-3-225630+8+656601+22000. 10000.1       N2+
  2  8  1 99  0  0  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61          O2-
-205250+5+267570+5+111480+2-656700-4-779100+7+699149+22000. 10000.1       O2-
-205250+5+267570+5+111480+2-656700-4-779100+7+699149+22000. 10000.1       O2-
  1  6  1  8 -1 99  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61          CO+
+294283+6+243830+5+893619+1+378000-4-150900+7+666595+22000. 10000.1       CO+
+294283+6+243830+5+893619+1+378000-4-150900+7+666595+22000. 10000.1       CO+
  1  7  1  8 -1 99  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61          NO+
+232919+6+241970+5+910216+1+277400-4-316600+7+654379+22000. 10000.1       NO+
+232919+6+241970+5+910216+1+277400-4-316600+7+654379+22000. 10000.1       NO+
  1  8 -1 99  0  0  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61          O+
+371999+6+149290+5+336271+1+306710-3+590200+7+484849+22000. 10000.1       O+
+371999+6+149290+5+336271+1+306710-3+590200+7+484849+22000. 10000.1       O+
  2  8 -1 99  0  0  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61          O2+
+279695+6+248730+5+594789+1+626340-3+103500+8+677731+22000. 10000.1       O2+
+279695+6+248730+5+594789+1+626340-3+103500+8+677731+22000. 10000.1       O2+
  1  8  1 99  0  0  0  0  0  0  0  0  0  0CONVAIR ZPH-122 12/61          O-
+245000+5+149430+5+216633+1+805240-3+532500+7+492947+22000. 10000.1       O-
+245000+5+149430+5+216633+1+805240-3+532500+7+492947+22000. 10000.1       O-
```

(1 blank card)

1.0	.9930	.9721	.9372	.8881	.8246	.7462	.6516
.5384	.3993	.21000	.17601	.10952	.05867	.0310	.01320
.0096	.0086	.0087	.0094	.012	.013	.014	.015
.016232	.016428	.016623	.016818	.017014			

(6 blank cards)

b. Output from Sample Case Number 3

Since the output for 29 body stations is lengthy, not all the output is shown here. Both the standard chemistry output for boundary layer edge expansions and the standard output for boundary layer solutions have been limited to only the first three body stations.

```
            BOUNDARY LAYER INTEGRAL MATRIX PROGRAM (BLIMP)

       AEROTHERM CORPORATION,PALO ALTO,CALIF (RMK,EPB)  24 OCT 69 15:48:29

   CASE TURBULENT B.L.  3 MATERIALS, C*,BN,C6H40

       CONTROL NUMBERS  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20

                        1  0  2  0  4  0  2  0  4  0  0  2  0  2  0  0  0  0  0  0

       PUNCH CONTROL
       IDENT   JSPEC
                 -0

    U/UE TO        NODAL PT.                                ETA VALUES
    NORM, ETA      AT WHICH
                   ETA NORM.
    9.500-01          11        0.000     2.400-02  4.000-02  7.200-02  1.200-01  2.000-01  3.200-01  4.800-01  8.000-01
                                1.400+00  2.000+00  3.200+00  5.000+00

   NOSE RADIUS,FT   4.16667-02     CONE HALF ANGLE   7.50000+00 DEGREES

   QUASI-STEADY ENERGY BALANCE AT THE WALL

     SURFACE NUMBER                          1              2              3
     SURFACE EMITTANCE                  1.00000+00     1.00000+00     1.00000+00
     ENTHALPY OF CHAR AT REFERENCE TEMP  0.00000       -4.30000+03    -3.58600+02
     ENTHALPY OF PYROLYSIS GAS (BTU/LB) -0.00000       -0.00000       -0.00000
     EQUILIBRIUM SURFACE SPECIES          C*             BN*            C*

   CASE                        1.00000+00

   TOTAL ENTHALPY,BTU/LB       5.52000+03

   TOTAL PRESSURE,ATM          1.20500+02

   INCIDENT RAD FLUX,B/SF2 -0.00000

     MIXING LENGTH CONSTANT   =  4.4000-01
     SUBLAYER CONSTANT, YA+   =  1.1283+01
     CLAUSER NUMBER           =  1.9000-02
     TURBULENT SCHMIDT NUMBER=  7.5000-01
     TURBULENT PRANDTL NUMBER=  7.5000-01
     TRANSITION MOM,THICK,RE =  2.5000+02
```

CASE 1 - 24 OCT 69 15:48:29

RELATIVE ELEMENTAL COMPOSITIONS, ATOMIC WTS/UNIT MASS

AT.NO.	ELEMENT	ATOMIC WT	EDGE GAS	PYRO.GAS 1	CHAR 1	PYRO.GAS 2	CHAR 2	PYRO.GAS 3	CHAR 3
1	HYDROGEN	1.00797	.0000000	-.0000000	.0000000	-.0000000	.0000000	-.0000000	.0207368
5	BORON	10.81100	.0000000	-.0000000	.0000000	-.0000000	.0402917	-.0000000	.0000000
6	CARBON	12.01115	.0000000	-.0000000	.0832570	-.0000000	.0000000	-.0000000	.0769039
7	NITROGEN	14.00670	.0546117	-.0000000	.0000000	-.0000000	.0402917	-.0000000	.0000000
8	OXYGEN	16.00000	.3144675	-.0000000	.0000000	-.0000000	.0000000	-.0000000	.0034628
99	ELECTRON	.00055	.0000000	-.0000000	.0000000	-.0000000	.0000000	-.0000000	.0000000

THERMODYNAMIC PROPERTY CURVE-FIT DATA (SEE MANUAL FOR FORMAT)

```
3.  6 0.  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 12/60                 C3
   .18967+06   .36622+05   .14644+02   .62254-   -.16823+07   .79841+02  500.0000  3000.0000 1
   .18967+06   .36622+05   .14478+02   .79223-04 -.64688+06   .79841+02 3000.0000  5000.0000 1
1.  6 0.  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61                 C*
   .00000      .14412+05   .58607+01   .95398-04 -.76662+06   .12129+02  500.0000  3000.0000 2
   .00000      .14412+05   .48513+01   .29161-03  .30720+07   .12129+02 3000.0000  5000.0000 2
1.  6 1.  8 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61                 CO
  -.26417+05   .22357+05   .86504+01   .11702-03 -.89821+06   .65370+02  500.0000  3000.0000 1
  -.26417+05   .22357+05   .11550+02  -.42414-03 -.13156+08   .65370+02 3000.0000  5000.0000 1
1.  1 0.  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 12/60                 H
   .52102+05   .13423+05   .48022+01   .55547-04  .17310+06   .38862+02  500.0000  3000.0000 1
   .52102+05   .13423+05   .30675+01   .31502-03  .92974+07   .38862+02 3000.0000  5000.0000 1
1.  5 1.  7 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 09/63                 BN
   .15200+06   .24462+05   .88011+01   .10879-03 -.11245+06   .69936+02  500.0000  3000.0000 1
   .15200+06   .24462+05   .88075+01   .99819-04  .72367+05   .69936+02 3000.0000  5000.0000 1
1.  5 1.  7-0. -0-0. -0-0. -0-0. -0-0. -OJANAF 9/63                  BN*
  -.59510+05   .29190+05   .11916+02   .23991-04 -.89107+06   .25705+02  500.0000  2500.0000 2
  -.59510+05   .29074+05   .11716+02   .25718-05 -.24003+06   .25662+02 2500.0000  5000.0000 2
2.  7 0.  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61                 N2
   .00000      .22165+05   .86270+01   .11609-03 -.10372+07   .63765+02  500.0000  3000.0000 1
   .00000      .22165+05   .98417+01  -.11623-03 -.61273+07   .63765+02 3000.0000  5000.0000 1
1.  6 0.  0 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61                 C
   .17089+06   .13550+05   .44443+01   .22812-03  .40983+06   .49287+02  500.0000  3000.0000 1
   .17089+06   .13550+05   .41221+01   .26191-03  .26289+07   .49287+02 3000.0000  5000.0000 1
1.  1 1.  6 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61                 CH
   .14201+06   .22130+05   .82678+01   .30221-03 -.10018+07   .61612+02  500.0000  3000.0000 1
   .14201+06   .22130+05   .70709+01   .46328-03  .55286+07   .61612+02 3000.0000  5000.0000 1
1.  1 1.  6 1.  7 0.  0 0.  0 0.  0 0.  OJANAF 03/61                 CHN
   .31200+05   .35593+05   .13722+02   .55224-03 -.22896+07   .75862+02  500.0000  3000.0000 1
   .31200+05   .35593+05   .17689+02  -.29505-03 -.18367+08   .75862+02 3000.0000  5000.0000 1
1.  1 1.  6 1.  8 0.  0 0.  0 0.  0 0.  OJANAF 03/61                 CHO
  -.29000+04   .32367+05   .12803+02   .30064-03 -.20172+07   .78983+02  500.0000  3000.0000 1
  -.29000+04   .32367+05   .10303+02   .63331-03  .12162+09   .78983+02 3000.0000  5000.0000 1
2.  1 1.  6 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 12/62                 CH2
   .95000+05   .32996+05   .13289+02   .41382-03 -.29027+07   .68494+02  500.0000  3000.0000 1
   .95000+05   .32996+05   .14073+02   .13215-03 -.23949+07   .68494+02 3000.0000  5000.0000 1
3.  1 1.  6 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 12/62                 CH3
   .31940+05   .43419+05   .18276+02   .40102-03 -.46120+07   .78604+02  500.0000  3000.0000 1
   .31940+05   .43419+05   .23490+02  -.10803-03 -.11469+08   .78604+02 3000.0000  5000.0000 1
4.  1 1.  6 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61                 CH4
  -.17895+05   .53079+05   .23095+02   .67790-03 -.75506+07   .82597+02  500.0000  3000.0000 1
  -.17895+05   .53079+05   .23605+02   .37432-03 -.36823+07   .82597+02 3000.0000  5000.0000 1
1.  6 1.  7 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 12/62                 CN
   .10900+06   .23249+05   .65591+01   .11533-02  .47952+06   .66976+02  500.0000  3000.0000 1
   .10900+06   .23249+05   .98801+01   .31385-03 -.64945+07   .66976+02 3000.0000  5000.0000 1
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1. 6 2. 8 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 03/61                 CO2
 -.94054+05  .36535+05  .14456+02  .21039-03 -.18239+07  .79848+02  500.0000  3000.0000 1
 -.94054+05  .36535+05  .15645+02 -.38156-04 -.60277+07  .79848+02 3000.0000  5000.0000 1
2. 6 0. 0 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 9/61                  C2
  .19900+06  .24699+05  .77661+01  .69608-03  .18565+06  .68552+02  500.0000  3000.0000 1
  .19900+06  .24699+05  .10416+02  .54684-04 -.64020+07  .68552+02 3000.0000  5000.0000 1
1. 1 2. 6 0. 0 0. 0 0. 0 0. 0 0. 0DUFF BAUER 6/61             C2H
  .11740+06  .34962+05  .13421+02  .46910-03 -.18751+07  .78114+02  500.0000  3000.0000 1
  .11740+06  .34962+05  .14852+02  .10940-03 -.50386+07  .78114+02 3000.0000  5000.0000 1
2. 1 2. 6 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 03/61                 C2H2
  .54190+05 -.48257+05  .18996+02  .76904-03 -.40904+07  .84969+02  500.0000  3000.0000 1
  .54190+05  .48257+05  .20395+02  .38906-03 -.64530+07  .84969+02 3000.0000  5000.0000 1
2. 6 2. 7 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 3/61                  C2N2
  .73870+05  .51107+05  .18874+02  .55986-03 -.89687+06  .98548+02  500.0000  3000.0000 1
  .73870+05  .51107+05  .20820+02  .63023-05 -.34686+07  .98548+02 3000.0000  5000.0000 1
1. 1 3. 6 0. 0 0. 0 0. 0 0. 0 0. 0DUFF BAUER 6/61             C3H
  .12770+06  .48962+05  .19446+02  .50838-03 -.31193+07  .92882+02  500.0000  3000.0000 1
  .12770+06  .48962+05  .19958+02  .24569-03 -.63251+06  .92882+02 3000.0000  5000.0000 1
2. 1 3. 6 0. 0 0. 0 0. 0 0. 0 0. 0DUFF BAUER 6/61             C3H2
  .10652+06  .63517+05  .24744+02  .99292-03 -.43760+07  .10467+03  500.0000  3000.0000 1
  .10652+06  .63517+05  .26662+02  .36477-03 -.46773+07  .10467+03 3000.0000  5000.0000 1
1. 1 1. 7 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 12/60                 HN
  .79200+05  .21766+05  .82313+01  .28155-03 -.12690+07  .60929+02  500.0000  3000.0000 1
  .79200+05  .21766+05  .76546+01  .35985-03  .18078+07  .60929+02 3000.0000  5000.0000 1
1. 1 1. 8 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 12/60                 HO
  .93300+04  .21404+05  .77319+01  .39439-03 -.97356+06  .61382+02  500.0000  3000.0000 1
  .93300+04  .21404+05  .96514+01 -.44353-04 -.68611+07  .61382+02 3000.0000  5000.0000 1
2. 1 0. 0 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 03/61                 H2
  .00000     .21210+05  .71196+01  .62195-03 -.71269+06  .48465+02  500.0000  3000.0000 1
  .00000     .21210+05  .68179+01  .58985-03  .24511+07  .48465+02 3000.0000  5000.0000 1
2. 1 1. 7 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 12/65                 H2N
  .40100+05  .30580+05  .97586+01  .11440-02 -.51897+06  .70158+02  500.0000  3000.0000 1
  .40100+05  .30580+05  .13742+02  .22949-04 -.61002+07  .70158+02 3000.0000  5000.0000 1
2. 1 1. 8 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 03/61                 H2O
 -.57798+05  .30201+05  .11225+02  .81140-03 -.26080+07  .68421+02  500.0000  3000.0000 1
 -.57798+05  .30201+05  .15728+02 -.19155-03 -.17360+08  .68421+02 3000.0000  5000.0000 1
1. 7 0. 0 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 03/61                 N
  .11296+06  .13437+05  .48694+01  .38332-04  .95846+05  .48090+02  500.0000  3000.0000 1
  .11296+06  .13437+05  .42896+01  .24084-03 -.41727+06  .48090+02 3000.0000  5000.0000 1
1. 7 1. 8 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 06/63                 NO
  .21580+05  .22700+05  .87762+01  .89903-04 -.78966+06  .68849+02  500.0000  3000.0000 1
  .21580+05  .22700+05  .91626+01  .65788-05 -.21252+07  .68849+02 3000.0000  5000.0000 1
1. 8 0. 0 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 06/62                 O
  .59559+05  .13522+05  .49723+01  .38077-05  .15475+05  .50096+02  500.0000  3000.0000 1
  .59559+05  .13522+05  .65749+01 -.22427-03 -.89178+07  .50096+02 3000.0000  5000.0000 1
2. 8 0. 0 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 03/61                 O2
  .00000     .23446+05  .80437+01  .51087-03 -.15272+06  .67973+02  500.0000  3000.0000 1
  .00000     .23446+05  .10307+02  .29099-04 -.78308+07  .67973+02 3000.0000  5000.0000 1
4. 6 0. 0 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 12/60                 C4
  .24232+06  .51123+05  .20590+02  .62344-04 -.25770+07  .98676+02  500.0000  3000.0000 1
  .24232+06  .51123+05  .21071+02 -.43489-04 -.40494+07  .98676+02 3000.0000  5000.0000 1
5. 6 0. 0 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 12/60                 C5
  .24237+06  .65623+05  .26471+02  .80653-04 -.33713+07  .11164+03  500.0000  3000.0000 1
  .24237+06  .65623+05  .27116+02 -.58027-04 -.54318+07  .11164+03 3000.0000  5000.0000 1
1. 5 0. 0 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 12/60                 B
  .13262+06  .13424+05  .50602+01 -.30711-04 -.98564+05  .48121+02  500.0000  3000.0000 1
  .13262+06  .13424+05  .50746+01 -.12184-04 -.72635+06  .48121+02 3000.0000  5000.0000 1
1. 5 1. 6 0. 0 0. 0 0. 0 0. 0 0. 0JANAF 06/63                 CB
  .19800+06  .23387+05  .88710+01  .98760-04 -.46167+06  .68965+02  500.0000  3000.0000 1
  .19800+06  .23387+05  .86450+01  .13478-03  .59985+06  .68965+02 3000.0000  5000.0000 1
```

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1.  1 1.  5 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/63              BH
  .10563+04   .22637+05   .67172+01   .19310-03  -.11388+07   .59324+02  500.0000  3000.0000 1
  .10563+04   .22637+05   .96234+01   .12765-04  -.44257+07   .59324+02 3000.0000  5000.0000 1
1.  1 1.  5 1.  8 0.  0 0.  0 0.  0 0.  OJANAF 12/60              BHO
 -.47127+05   .35603+05   .14237+02   .16762-03  -.20114+07   .76473+02  500.0000  3000.0000 1
 -.47127+05   .35603+05   .11239+02   .64446-03   .13497+08   .76473+02 3000.0000  5000.0000 1
1.  1 1.  5 2.  8 0.  0 0.  0 0.  0 0.  OJANAF 06/63              BHO2
 -.13410+06   .45664+05   .18228-02   .42511-03  -.30104+07   .92490+02  500.0000  3000.0000 1
 -.13410+06   .45664+05   .16675+02   .52116-03   .69980+07   .92490+02 3000.0000  5000.0000 1
2.  1 1.  5 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 12/60              BH2
  .66000+05   .32748+05   .13182+02   .19930-03  -.21135+07   .72822+02  500.0000  3000.0000 1
  .66000+05   .32748+05   .13341+02   .90770-04  -.58007+06   .72822+02 3000.0000  5000.0000 1
2.  1 1.  5 2.  8 0.  0 0.  0 0.  0 0.  OJANAF 12/60              BH202
 -.45000+05   .59706+05   .24631+02   .26348-03  -.47632+07   .10907+03  500.0000  3000.0000 1
 -.45000+05   .59706+05   .24601+02   .20604-03  -.24431+07   .10907+03 3000.0000  5000.0000 1
3.  1 1.  5 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 12/60              BH3
  .18000+05   .42459+05   .17901+02   .50161-03  -.49571+07   .76379+02  500.0000  3000.0000 1
  .18000+05   .42459+05   .19689+02   .21406-03  -.46413+07   .76379+02 3000.0000  5000.0000 1
3.  1 1.  5 3.  8 0.  0 0.  0 0.  0 0.  OJANAF 03/61              BH303
 -.23860+06   .86073+05   .35695+02   .47849-03  -.72042+07   .13181+03  500.0000  3000.0000 1
 -.23860+06   .86073+05   .37753+02  -.10530-04  -.12724+08   .13181+03 3000.0000  5000.0000 1
1.  5 1.  8 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 06/62              BO
  .57440+04   .22645+05   .86220+01   .13698-03  -.63170+06   .67024+02  500.0000  3000.0000 1
  .57440+04   .22645+05   .80349+01   .21025-03   .26465+07   .67024+02 3000.0000  5000.0000 1
1.  5 2.  8 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 06/63              BO2
 -.72670+05   .37930+05   .14655+02   .11940-04  -.99944+06   .85636+02  500.0000  3000.0000 1
 -.72670+05   .37930+05   .11827+02   .63777-03   .93586+07   .85636+02 3000.0000  5000.0000 1
2.  5 0.  0 0.  0 0.  0 0.  0 1.  0 0.  OJANAF 12/60              B2
  .19930+06   .23809+05   .89102+01   .11209-03  -.32196+06   .67851+02  500.0000  3000.0000 1
  .19930+06   .23809+05   .72443+01   .41256-03   .68792+07   .67851+02 3000.0000  5000.0000 1
4.  1 2.  5 4.  8 0.  0 0.  0 0.  0 0.  OJANAF 03/66              B2H404
 -.30770+06   .12574+06   .45089+02   .26603-02  -.33241+07   .17964+03  500.0000  3000.0000 1
 -.30770+06   .12574+06   .54312+02   .45039-04  -.15723+08   .17964+03 3000.0000  5000.0000 1
6.  1 2.  5 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 12/64              B2H6
  .98000+04   .95765+05   .34157+02   .27437-02  -.38017+07   .12554+03  500.0000  3000.0000 1
  .98000+04   .95765+05   .43529+02   .25889-04  -.14763+08   .12554+03 3000.0000  5000.0000 1
2.  5 2.  8 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61              B202
 -.11160+06   .51550+05   .20788+02   .37045-05  -.25133+07   .98397+02  500.0000  3000.0000 1
 -.11160+06   .51550+05   .19664+02   .20315-03   .28491+07   .98397+02 3000.0000  5000.0000 1
2.  5 3.  8 0.  0 0.  0 0.  0 0.  0 0.  OJANAF 03/61              B203
 -.21010+06   .61507+05   .25778+02  -.15367-04  -.42751+07   .11171+03  500.0000  3000.0000 1
 -.21010+06   .61507+05   .23929+02   .34577-03   .32940+0    .11171+03 3000.0000  5000.0000 1
1. 99 0.  0 0.  0 0.  0 0.  0 0.  0 0.  OCONVAIR ZPH-122 12/61    E-
 -.00070      .14901+05   .49885+01  -.27280-05  -.13590+06   .16456+02 2000.0000 10000.0000 1
 -.00070      .14901+05   .49885+01  -.27280-05  -.13590+06   .16456+02 2000.0000 10000.0000 1
1.  6-1, 99 0.  0 0.  0 0.  0 0.  0 0.  OCONVAIR ZPH-122 12/61    C+
  .42899+06   .15012+05   .48966+01   .18070-04   .34000+05   .48423+02 2000.0000 10000.0000 1
  .42899+06   .15012+05   .48966+01   .18070-04   .34000+05   .48423+02 2000.0000 10000.0000 1
1.  7-1, 99 0.  0 0.  0 0.  0 0.  0 0.  OCONVAIR ZPH-122 12/61    N+
  .44664+06   .15131+05   .50175+01   .61710-04  -.18410+07   .49685+02 2000.0000 10000.0000 1
  .44664+06   .15131+05   .50175+01   .61710-04  -.18410+07   .49685+02 2000.0000 10000.0000 1
2.  7-1, 99 0.  0 0.  0 0.  0 0.  0 0.  OCONVAIR ZPH-122 12/61    N2+
  .35726+06   .25147+05   .13651+02  -.32794-03  -.22563+08   .65660+02 2000.0000 10000.0000 1
  .35726+06   .25147+05   .13651+02  -.32794-03  -.22563+08   .65660+02 2000.0000 10000.0000 1
2.  8 1, 99 0.  0 0.  0 0.  0 0.  0 0.  OCONVAIR ZPH-122 12/61    O2-
 -.20525+05   .26757+05   .11148+02  -.65670-04  -.77910+07   .69915+02 2000.0000 10000.0000 1
 -.20525+05   .26757+05   .11148+02  -.65670-04  -.77910+07   .69915+02 2000.0000 10000.0000 1
1.  6 1.  8-1. 99 0.  0 0.  0 0.  0 0.  OCONVAIR ZPH-122 12/61    CO+
  .29428+06   .24383+05   .89362+01   .37800-04  -.15090+07   .66659+02 2000.0000 10000.0000 1
  .29428+06   .24383+05   .89362+01   .37800-04  -.15090+07   .66659+02 2000.0000 10000.0000 1
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1.   7 1.  8-1.  99 0.   0 0.    0 0.   0 0.   0CONVAIR ZPH-122 12/61              NO+
   .23292+04   .24197+05    .91022+01    .27740-04   -.31660+07   .65438+02 2000.0000 10000.0000 1
   .23292+04   .24197+05    .91022+01    .27740-04   -.31660+07   .65438+02 2000.0000 10000.0000 1
1.   8-1.  99 0.   0 0.    0 0.   0 0.   0 0.   0CONVAIR ZPH-122 12/61               O+
   .37200+04   .14929+05    .33627+01    .30671-03    .59020+07   .48485+02 2000.0000 10000.0000 1
   .37200+04   .14929+05    .33627+01    .30671-03    .59020+07   .48485+02 2000.0000 10000.0000 1
2.   8-1.  99 0.   0 0.    0 0.   0 0.   0 0.   0CONVAIR ZPH-122 12/61               O2+
   .27970+04   .24873+05    .59479+01    .62634-03    .10350+08   .67773+02 2000.0000 10000.0000 1
   .27970+04   .24873+05    .59479+01    .62634-03    .10350+08   .67773+02 2000.0000 10000.0000 1
1.   8 1.  99 0.   0 0.    0 0.   0 0.   0 0.   0CONVAIR ZPH-122 12/61               O-
   .24500+05   .14943+05    .21663+01    .80524-03    .53250+07   .49295+02 2000.0000 10000.0000 1
   .24500+05   .14943+05    .21663+01    .80524-03    .53250+07   .49295+02 2000.0000 10000.0000 1
```

ELEMENT	HYDROGEN	BORON	CARBON	NITROGEN	OXYGEN	ELECTRON
BASE SP	H	BN	C3	N2	CO	E-

MOLECULAR TRANSPORT PROPERTIES

VISCOSITY ..... BUDDENBERG - WILKE MIXTURE FORMULA WITH MU(I) CALCULATED ON THE BASIS OF D(I,I) = DBAR/G(I)**2

THERMAL CONDUCTIVITY ..... MASON - SAXENA MIXTURE FORMULA WITH EUCKEN CORRECTION

DIFFUSION COEFFICIENTS ..... D(I,J) = DBAR/(F(I)*F(J)) WITH DBAR BASED ON SIGMA = 3.4670, EPOVRK = 106.7000, AND MREF = 32.0000

METHODS EMPLOYED

0 CONDENSED PHASE, VALUES FOR F(I) AND G(I) SET EQUAL TO 1.E+10

1 VALUES FOR F(I) (OR G(I)) INPUT DIRECTLY

2 VALUES FOR F(I) (OR G(I)) CALCULATED BY F(I) =(M(I)/FITMOL)**FFA AND G(I) = (M(I)/FITGMW)**GGA WHERE M(I) IS SPECIES MOLECULAR WEIGHT, FITMOL = 23.4000, AND FFA = .4310, FITGMW = 24.3000, AND GGA = .4540

3 VALUES FOR G(I) CALCULATED BY G(I) = SQRT(DBAR/D(I,I)) = (SIGMA(I)/SIGMA) * (EPS(I)/EPOVRK) **0.0795 * (M(I)/MREF) **0.25 WHERE SIGMA(I) AND EPS(I) ARE GIVEN WITH THERMODYNAMIC DATA

SPECIES	F(I)	METHOD	G(I)	METHOD	SPECIES	F(I)	METHOD	G(I)	METHOD
C3	1.204	2	1.196	2	CO	1.081	2	1.067	2
H	.258	2	.236	2	BN	1.026	2	1.010	2
N2	1.081	2	1.067	2	E-	.010	2	.008	2
C*	*****	0	*****	0	BN*	*****	0	*****	0
C	.750	2	.726	2	CH	.777	2	.753	2
CHN	1.064	2	1.049	2	CHO	1.097	2	1.084	2
CH2	.802	2	.779	2	CH3	.826	2	.804	2
CH4	.850	2	.828	2	CN	1.047	2	1.032	2
CO2	1.313	2	1.310	2	C2	1.011	2	.995	2
C2H	1.029	2	1.014	2	C2H2	1.047	2	1.032	2
C2N2	1.411	2	1.413	2	C3H	1.219	2	1.211	2
C3H2	1.233	2	1.226	2	HN	.826	2	.804	2
HO	.872	2	.850	2	H2	.348	2	.323	2
H2N	.849	2	.828	2	H2O	.893	2	.873	2
N	.802	2	.779	2	NO	1.113	2	1.101	2

O	.849	2	.827	2	O2	1.144	2	1.133	2
C4	1.363	2	1.363	2	C5	1.501	2	1.508	2
B	.717	2	.692	2	CB	.989	2	.972	2
BH	.745	2	.721	2	BHO	1.077	2	1.063	2
BHO2	1.310	2	1.307	2	BH2	.772	2	.748	2
BH2O2	1.323	2	1.320	2	BH3	.797	2	.774	2
BH3O3	1.520	2	1.528	2	BO	1.060	2	1.046	2
BO2	1.297	2	1.293	2	B2	.967	2	.948	2
B2H4O4	1.784	2	1.809	2	B2H6	1.075	2	1.061	2
B2O2	1.430	2	1.432	2	B2O3	1.600	2	1.613	2
C+	.750	2	.726	2	N+	.802	2	.779	2
N2+	1.081	2	1.067	2	O2-	1.144	2	1.133	2
CO+	1.081	2	1.067	2	NO+	1.113	2	1.101	2
O+	.849	2	.827	2	O2+	1.144	2	1.133	2
O-	.849	2	.827	2					

STAGNATION SOLUTION FOLLOWED BY BOUNDARY-LAYER EDGE EXPANSION

CP-FROZEN	CP-EQUIL	DLNM/DLNT	DLNM/DLNP	GAMMA
.31804-00	.76172-00	-.37712-00	.31549-01	.12120+01

TEMP = 6862.4293 DEG-K PRES =120.5000 ATM MOL WT = 23.9563580
RELATIVE MASSES OF COMPONENTS 1,2 AND 3 .00000 .00000 .00000
ENTHALPY = .3066667+04 CAL/GM ENTROPY = .24288+01 CAL/GM-DEG K
DENSITY = .319990-00 LB/CUFT
VEL = .000 FT/SEC MACH = -.000 AREA = .000 SQFT/LB/SEC

SPECIES	MOLE FR.	SPECIES	MOLE FR.	SPECIES	MOLE FR.
C3	.00000	CO	.00000	H	.00000
BN	.00000	N2	.59702-00	E-	.17998-03
C*	.00000	BN*	.00000	C	.00000
CH	.00000	CN*	.00000	CHO	.00000
CH2	.00000	CH3	.00000	CH4	.00000
CN	.00000	CO2	.00000	C2	.00000
C2H	.00000	C2H2	.00000	C2N2	.00000
C3H	.00000	C3H2	.00000	HN	.00000
HO	.00000	H2	.00000	H2N	.00000
H2O	.00000	N	.57771-01	NO	.56286-01
O	.28169-00	O2	.68294-02	C4	.00000
C5	.00000	B	.00000	C8	.00000
BH	.00000	BHO	.00000	BHO2	.00000
BH2	.00000	BH2O2	.00000	BH3	.00000
BH3O3	.00000	BO	.00000	BO2	.00000
B2	.00000	B2H4O4	.00000	B2H6	.00000
B2O2	.00000	B2O3	.00000	C+	.00000
N+	.31313-06	N2+	.78745-06	O2-	.57541-06
CO+	.00000	NO+	.19797-03	O+	.14856-05
O2+	.74072-06	O-	.20750-04		

CP-FROZEN	CP-EQUIL	DLNM/DLNT	DLNM/DLNP	GAMMA
.31804-00	.76058-00	-.37618-00	.31478-01	.12121+01

TEMP = 6855.2024 DEG-K PRES =119.6565 ATM MOL WT = 23.9605620
RELATIVE MASSES OF COMPONENTS 1,2 AND 3 .00000 .00000 .00000
ENTHALPY = .3062671+04 CAL/GM ENTROPY = .24288+01 CAL/GM-DEG K

DENSITY = .318141-00 LB/CUFT
VEL = .600+03 FT/SEC MACH = .108+00 AREA = .524-02 SQFT/LB/SEC

SPECIES	MOLE FR.	SPECIES	MOLE FR.	SPECIES	MOLE FR.
C3	.00000	CO	.00000	H	.00000
BN	.00000	N2	.59729-00	E-	.17890-03
C*	.00000	BN*	.00000	C	.00000
CH	.00000	CHN	.00000	CHO	.00000
CH2	.00000	CH3	.00000	CH4	.00000
CN	.00000	CO2	.00000	C2	.00000
C2H	.00000	C2H2	.00000	C2N2	.00000
C3H	.00000	C3H2	.00000	HN	.00000
HO	.00000	H2	.00000	H2N	.00000
H2O	.00000	N	.57456-01	NO	.56287-01
O	.28172-07	O2	.68475-02	C4	.00000
C5	.00000	B	.00000	CB	.00000
BH	.00000	BHO	.00000	BHO2	.00000
BH2	.00000	BH2O2	.00000	BH3	.00000
BH3O3	.00000	BO	.00000	BO2	.00000
B2	.00000	B2H4O4	.00000	B2H6	.00000
B2O2	.00000	B2O3	.00000	C+	.00000
N+	.30663-06	N2+	.77372-06	O2-	.57168-06
CO+	.00000	NO+	.19678-03	O+	.14552-05
O2+	.73440-06	O-	.20583-04		

CP-FROZEN	CP-EQUIL	DLNM/DLNT	DLNM/DLNP	GAMMA
.31806-00	.75715-00	-.37337-00	.31264-01	.12124+01

TEMP = 6833.3364 DEG-K PRES =117.1380 ATM MOL WT = 23.9732650
RELATIVE MASSES OF COMPONENTS 1,2 AND 3 .00000 .00000 .00000
ENTHALPY = .3050601+04 CAL/GM ENTROPY = .24288+01 CAL/GM-DEG K
DENSITY = .312607-00 LB/CUFT
VEL = .120+04 FT/SEC MACH = .216-00 AREA = .266-02 SQFT/LB/SEC

SPECIES	MOLE FR.	SPECIES	MOLE FR.	SPECIES	MOLE FR.
C3	.00000	CO	.00000	H	.00000
BN	.00000	N2	.59811-00	E-	.17568-03
C*	.00000	BN*	.00000	C	.00000
CH	.00000	CHN	.00000	CHO	.00000
CH2	.00000	CH3	.00000	CH4	.00000
CN	.00000	CO2	.00000	C2	.00000
C2H	.00000	C2H2	.00000	C2N2	.00000
C3H	.00000	C3H2	.00000	HN	.00000
HO	.00000	H2	.00000	H2N	.00000
H2O	.00000	N	.56508-01	NO	.56292-01
O	.28179-07	O2	.69032-02	C4	.00000
C5	.00000	B	.00000	CB	.00000
BH	.00000	BHO	.00000	BHO2	.00000
BH2	.00000	BH2O2	.00000	BH3	.00000
BH3O3	.00000	HO	.00000	BO2	.00000
B2	.00000	B2H4O4	.00000	B2H6	.00000
B2O2	.00000	B2O3	.00000	C+	.00000
N+	.28769-06	N2+	.73337-06	O2-	.56054-06
CO+	.00000	NO+	.19318-03	O+	.14048-05
O2+	.71556-06	O-	.20084-04		

DISTANCE,FT	.00000	.41736-02	.83899-02	.12695-01	.17147-01	.21817-01	.26812-01	.32308-01
	.38637-01	.46657-01	.59975-01	.62727-01	.70000-01	.75000-01	.77500-01	.87500-01
	.10000+00	.12500-00	.15000-00	.20000-00	.30000-00	.50000-00	.70000-00	.10000+01
	.15000+01	.20000+01	.30000+01	.40000+01	.50164+01			
ROKAF	.00000	.41667-02	.83333-02	.12500-01	.16667-01	.20833-01	.25000-01	.29167-01
	.33333-01	.37500-01	.41308-01	.41667-01	.42615-01	.43267-01	.43593-01	.44897-01
	.46526-01	.49786-01	.53045-01	.59564-01	.72601-01	.98674-01	.12475+00	.16386-00
	.22965-00	.29424-00	.42461-00	.55499-00	.68750-00			
XI,(LB/SEC)**2	.00000	.31167-09	.38029-08	.27772-07	.77973-07	.18400-06	.37794-06	.70189-06
	.12149-05	.20127-05	.33464-05	.36016-05	.41252-05	.43793-05	.44577-05	.45959-05
	.47390-05	.49937-05	.52746-05	.59727-05	.82382-05	.16966-04	.32599-04	.74266-04
	.21253-03	.46442-03	.14288-02	.32280-02	.61925-02			
PRESSURE RATIO	.10000+01	.99300-00	.97210-00	.93720-00	.88810-00	.82460-00	.74620-00	.65160-00
	.53840-00	.39930-00	.21000-00	.17601-00	.10952+00	.58670-01	.31000-01	.13200-01
	.96000-02	.86000-02	.87000-02	.94000-02	.12000-01	.13000-01	.14000-01	.15000-01
	.16232-01	.16428-01	.16623-01	.16818-01	.17014-01			
STATIC PRESSURE,ATM	.12050+03	.11966+03	.11714+03	.11293+03	.10702+03	.99364+02	.89917+02	.78518+02
	.64877+02	.48116+02	.25305+02	.21209+02	.13197+02	.70697+01	.37355+01	.15906+01
	.11568+01	.10363+01	.10483+01	.11327+01	.14460+01	.15665+01	.16870+01	.18075+01
	.19560+01	.19796+01	.20031+01	.20266+01	.20502+01			
EDGE VELOCITY,FT/SEC	.00000	.60006+03	.12032+04	.18186+04	.24542+04	.31185+04	.38255+04	.45998+04
	.54841+04	.65904+04	.83517+04	.87430+04	.96616+04	.10652+05	.11487+05	.12407+05
	.12706+05	.12805+05	.12795+05	.12725+05	.12499+05	.12422+05	.12349+05	.12281+05
	.12201+05	.12189+05	.12177+05	.12165+05	.12153+05			
BETA	.50000-00	.54475-00	.42050-00	.61778-00	.56159-00	.55974-00	.57831-00	.61711-00
	.67893-00	.79160-00	.11564+01	.14415+01	.19436+01	.62640+01	.87859+01	.79601-00
	.49692-00	-.11034+00	-.88462-01	-.12017+00	-.72529-01	-.34192-02	-.16178-01	-.12932-01
	-.75197-02	-.29620-03	-.17534-02	-.27359-02	-.33125-02			
INCIDENT RADIATION FLUX	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
	.00000	.00000	.00000	.00000	.00000			
ENTROPY DROP,BTU/LB R	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
	.00000	.00000	.00000	.00000	.00000			
*1/FLUX NORM,PARAMETER	-.33202-00	-.38081-00	-.33825-00	-.41693-00	-.40794-00	-.42237-00	-.45075-00	-.49599-00
	-.57068-00	-.71499-00	-.11948+01	-.13761+01	-.20136+01	-.32889+01	-.54993+01	-.11069+02
	-.14237+02	-.15012+02	-.14338+02	-.12712+02	-.99387+01	-.98025+01	-.10092+02	-.10938+02
	-.12384+02	-.14107+02	-.16976+02	-.19332+02	-.21405+02			

CASE 1 - - - - - - - - - - - - STREAMWISE DIMENSION .00000 FEET - - - -24 OCT 69 15:45:29

ITERATED VALUES

ITS	TIME	ALPH	FPPW	DAMP	MAX.LIN ERROR		MAX.ERRORS IN CONSERVATION EQS. MOMENTUM		ENERGY		C3		CO		H		BN	
1	17,871	1.869	.6513	,2276	1.+00	14	-7.3-01	1	1.2+03	1	2.2-01	1	-7.7-02	2	-0.0	2	-0.0	0
2	25,543	1.768	.6283	,2010	8.-01	14	-5.6-01	1	-1.6+03	1	2.5-01	1	-8.7-02	2	-0.0	2	-0.0	0
3	31,863	1.705	.6065	,1742	7.-01	14	-4.4-01	1	-2.0+03	1	2.9-01	1	-1.0-01	2	-0.0	2	-0.0	0
4	39,006	1.594	.5808	,3353	5.-01	14	-3.6-01	1	-1.1+03	1	1.5-01	1	-5.2-02	2	-0.0	2	-0.0	0
5	48,389	1.435	.5849	,4654	4.-01	14	-2.4-01	1	8.6+02	1	5.4-02	1	-1.9-02	2	-0.0	2	-0.0	0
6	56,110	1.291	,5641	,7535	2.-01	14	-1.3-01	1	5.7+02	1	5.4-02	1	-1.9-02	2	-0.0	2	-0.0	0
7	63,724	1.260	,5510	1,0000	5.-02	14	-3.2-02	1	1.5+02	1	3.0-02	1	-1.0-02	2	-0.0	2	-0.0	0
8	70,523	1.263	.5542	1,0000	4.-07	11	-1.0-02	9	-6.3+01	1	2.3-03	1	-7.9-04	2	-0.0	2	-0.0	0
9	76,071	1.262	.5552	1,0000	6.-08	11	-5.9-04	9	-8.6+00	8	1.1-04	8	-3.7-05	2	-0.0	2	-0.0	0
10	80,635	1.262	.5552	1,0000	6.-08	13	4.3-05	10	1.0-01	9	-7.3-06	9	2.6-06	2	-0.0	2	-0.0	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC SQ FT)	RERAD	QCOND
1,262+00	0.000	0,000	1.205+02	0.000	5.000-01	3.012+00	3.991+03	2.162+03	2.162+03	4.930+03

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	BORON	CARBON	NITROGEN	OXYGEN
-0,000	0.000	0,000	5.703-01	5.704-01	-0.000	-0,000	-4.259-01	3.258-01	1.001-01

MOM TRANS COEFF. RHO*UE*CF/2	HEAT TRANS COEFF. RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	BORON	CARBON	NITROGEN	OXYGEN
2,368+00	1.725+00	0,000	3.306-01	3.306-01	-0.000	-0.000	1.682+00	1.682+00	1.682+00

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	BORON	CARBON	NITROGEN	OXYGEN
1,153-05	1.885-05	2,404-05	2,088-05	0,000	-0.000	-0.000	2,048-05	2.047-05	2.048-05

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0,000	0.000	-1,894-01	0.000	5.552-01	-0,000	3.207+03	6.647+02	9.661+01	3.207+03	8.188+03	1.039+13
4,585-07	3.030-02	-1,891-01	1.682-02	5.553-01	0.000	3.227+03	6.708+02	3.035+02	3.227+03	8.263+03	1.034+13
7,673-07	5.050-02	-1,887-01	2.804-02	5.554-01	0.000	3.240+03	6.748+02	9.836+01	3.240+03	8.313+03	1.031+13
1,393-06	9.090-02	-1,871-01	5.047-02	5.553-01	0.000	3.268+03	6.829+02	3.040+02	3.268+03	8.416+03	1.025+13
2,351-06	1.515-01	-1,830-01	8.413-02	5.549-01	0.000	3.310+03	6.951+02	9.888+01	3.310+03	8.574+03	1.015+13
4,003-06	2.525-01	-1,717-01	1.401-01	5.532-01	0.000	3.381+03	7.151+02	2.963+02	3.381+03	8.853+03	9.989+12
6,623-06	4.040-01	-1,441-01	2.236-01	5.480-01	0.000	3.491+03	7.429+02	7.045+01	3.491+03	9.331+03	9.730+12
1,042-05	6.060-01	-8,786-02	3.330-01	5.347-01	0.000	3.644+03	7.715+02	2.129+02	3.644+03	1.015+04	9.331+12
1,930-05	1.010+00	8,907-02	5.388-01	4.728-01	0.000	3.973+03	8.555+02	2.027+02	3.973+03	1.209+04	8.547+12
3,874-05	1.767+00	6,143-01	8.217-01	2.646-01	0.000	4.631+03	8.198+02	-2.968+02	4.631+03	1.273+04	8.330+12
5,908-05	2.525+00	1,293+00	9.500-01	9.760-02	0.000	5.146+03	5.105+02	-5.199+02	5.146+03	1.254+04	8.394+12
1,004-04	4.040+00	2,789+00	9.999-01	3.744-04	0.000	5.493+03	6.027+01	-7.444+01	5.493+03	1.237+04	8.452+12
1,626-04	6.312+00	5,061+00	1.000+00	0.000	0.000	5.520+03	0.000	2.139+01	5.520+03	1.235+04	8.457+12

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSG*EPS /RHOE*MUE	MACH NUMBER
0.000	5.827-01	6,415-05	1.416+00	3.377-01	3.029-05	7.151-01	7.350-01	2.892+01	0.000	0.000

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4.585-07  5.755-01  6.451-05  1.407+00  3.375-01  3.045-05  7.148-01  7.351-01  2.882+01  0.000     0.000
7.673-07  5.707-01  6.475-05  1.400+00  3.373-01  3.056-05  7.146-01  7.351-01  2.876+01  0.000     0.000
1.393-06  5.613-01  6.524-05  1.387+00  3.369-01  3.078-05  7.142-01  7.352-01  2.863+01  0.000     0.000
2.351-06  5.472-01  6.600-05  1.368+00  3.364-01  3.111-05  7.136-01  7.353-01  2.844+01  0.000     0.000
4.003-06  5.242-01  6.733-05  1.337+00  3.355-01  3.170-05  7.126-01  7.355-01  2.813+01  0.000     0.000
6.623-06  4.898-01  6.959-05  1.292+00  3.338-01  3.267-05  7.110-01  7.359-01  2.770+01  0.000     0.000
1.042-05  4.431-01  7.344-05  1.233+00  3.305-01  3.424-05  7.090-01  7.365-01  2.725+01  0.000     0.000
1.930-05  3.649-01  8.235-05  1.139+00  3.204-01  3.736-05  7.063-01  7.375-01  2.675+01  0.000     0.000
3.874-05  3.307-01  8.457-05  1.060+00  3.166-01  3.789-05  7.066-01  7.370-01  2.552+01  0.000     0.000
5.908-05  3.234-01  8.340-05  1.022+00  3.173-01  3.745-05  7.067-01  7.379-01  2.458+01  0.000     0.000
1.004-04  3.202-01  8.255-05  1.001+00  3.180-01  3.717-05  7.063-01  7.394-01  2.400+01  0.000     0.000
1.626-04  3.200-01  8.248-05  1.000+00  3.180-01  3.714-05  7.062-01  7.396-01  2.396+01  0.000     0.000

                                    DISTANCE FROM WALL,FT
          0.000     4.585-07  7.673-07  1.393-06  2.351-06  4.003-06  6.623-06  1.042-05  1.930-05  3.874-05
               5.908-05  1.004-04  1.626-04

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

   C3     1.215-01  1.189-01  1.171-01  1.136-01  1.081-01  9.881-02  8.423-02  6.374-02  1.927-02 -6.491-02
              -1.293-01 -1.729-01 -1.764-01
         -8.632-02 -8.719-02 -8.777-02 -8.895-02 -9.074-02 -9.379-02 -9.848-02 -1.047-01 -1.137-01 -1.027-01
              -6.390-02 -7.658-03  0.000
         -2.266-02 -3.438-02 -2.323-02 -3.494-02 -2.425-02 -3.609-02 -2.583-02 -3.562-02 -8.861-03  3.773-02
               6.481-02  9.434-03 -2.694-03
   CO     3.072-01  3.081-01  3.088-01  3.100-01  3.119-01  3.152-01  3.203-01  3.274-01  3.430-01  3.724-01
               3.949-01  4.102-01  4.114-01
          3.019-02  3.049-02  3.069-02  3.111-02  3.173-02  3.280-02  3.444-02  3.661-02  3.975-02  3.593-02
               2.235-02  2.678-03  0.000
          7.932-03  1.202-02  8.131-03  1.221-02  8.487-03  1.262-02  9.035-03  1.246-02  3.099-03 -1.320-02
              -2.266-02 -3.299-03  9.422-04
   H      0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
               0.000     0.000     0.000
          0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
               0.000     0.000     0.000
          0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
               0.000     0.000     0.000
   BN     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
               0.000     0.000     0.000
          0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
               0.000     0.000     0.000
          0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
               0.000     0.000     0.000
   N2     5.713-01  5.730-01  5.741-01  5.764-01  5.800-01  5.860-01  5.955-01  6.088-01  6.377-01  6.925-01
               7.344-01  7.627-01  7.650-01
          5.614-02  5.670-02  5.708-02  5.784-02  5.901-02  6.099-02  6.404-02  6.807-02  7.392-02  6.681-02
               4.155-02  4.980-03 -0.000
          1.473-02  2.237-02  1.510-02  2.273-02  1.576-02  2.347-02  1.679-02  2.316-02  5.762-03 -2.454-02
              -4.214-02 -6.135-03  1.752-03

MOLE FRACTIONS

   C3     3.634-02  3.498-02  3.401-02  3.195-02  2.857-02  2.239-02  1.277-02  3.247-03  1.610-05  1.081-08
               7.736-11  8.789-15  0.000
   CO     3.172-01  3.170-01  3.170-01  3.168-01  3.166-01  3.165-01  3.167-01  3.183-01  3.158-01  1.946-01
               8.044-02  5.827-03  0.000
   H      0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
               0.000     0.000     0.000
   BN     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
               0.000     0.000     0.000
```

N2	5.346-01	5.353-01	5.358-01	5.367-01	5.380-01	5.401-01	5.440-01	5.527-01	5.725-01	5.817-01	5.907-01	5.965-01	5.970-01
E-	1.164-07	1.404-07	1.590-07	2.035-07	2.943-07	5.422-07	1.384-06	5.222-06	5.090-05	1.569-04	1.801-04	1.803-04	1.800-04
C*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BN*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	7.195-03	7.926-03	8.447-03	9.566-03	1.146-02	1.524-02	2.247-02	3.361-02	2.813-02	3.740-03	6.382-04	2.764-05	0.000
CH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CHN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CHO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CH2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CH3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CH4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CN	5.139-02	5.325-02	5.448-02	5.689-02	6.035-02	6.544-02	7.019-02	6.572-02	2.361-02	2.535-03	4.648-04	2.147-05	0.000
CO2	2.214-06	2.307-06	2.373-06	2.517-06	2.767-06	3.311-06	4.654-06	9.523-06	8.870-05	4.398-04	3.748-04	3.917-05	0.000
C2	1.589-02	1.666-02	1.717-02	1.815-02	1.950-02	2.118-02	2.142-02	1.529-02	1.294-03	1.313-05	4.493-07	9.778-10	0.000
C2H	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C2H2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C2N2	2.905-02	2.711-02	2.584-02	2.339-02	1.990-02	1.463-02	8.034-03	2.330-03	3.817-05	2.550-07	1.005-08	2.482-11	0.000
C3H	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C3H2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
HN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
HO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H2N	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H2O	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	6.849-04	7.699-04	8.322-04	9.719-04	1.227-03	1.814-03	3.357-03	8.444-03	4.694-02	7.396-02	6.542-02	5.835-02	5.777-02
NO	2.479-06	2.813-06	3.063-06	3.636-06	4.733-06	7.509-06	1.650-05	6.419-05	1.977-03	2.163-02	4.120-02	5.515-02	5.629-02
O	2.828-06	3.339-06	3.733-06	4.674-06	6.590-06	1.196-05	3.244-05	1.726-04	9.465-03	1.201-01	2.169-01	2.771-01	2.817-01
O2	6.798-11	8.383-11	9.654-11	1.285-10	2.000-10	4.366-10	1.684-09	1.823-08	9.349-06	9.500-04	3.542-03	6.539-03	6.829-03
C4	3.076-03	2.903-03	2.784-03	2.539-03	2.159-03	1.526-03	6.983-04	1.073-04	8.395-08	4.845-12	6.719-15	3.715-20	0.000
C5	4.568-03	4.012-03	3.665-03	3.026-03	2.203-03	1.179-03	3.287-04	2.028-05	1.177-09	4.802-15	1.366-18	3.874-25	0.000

B	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BHO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BHO2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BH2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BH2O2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BH3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BH3O3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BO2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2H4O4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2H6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2O2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2O3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C+	1.016-07	1.233-07	1.399-07	1.798-07	2.614-07	4.844-07	1.238-06	4.548-06	2.474-05	3.185-06	3.441-07	1.111-08	0.000
N+	7.690-12	1.025-11	1.241-11	1.821-11	3.244-11	8.626-11	4.127-10	4.633-09	5.047-07	1.029-06	5.396-07	3.258-07	3.131-07
N2+	4.753-10	5.803-10	6.630-10	8.654-10	1.295-09	2.570-09	7.786-09	4.452-08	1.422-06	2.118-06	1.207-06	8.130-07	7.875-07
O2-	1.869-17	2.702-17	3.432-17	5.551-17	1.154-16	4.056-16	3.217-15	9.391-14	2.408-10	6.253-08	2.527-07	5.497-07	5.754-07
CO+	1.237-08	1.448-08	1.609-08	1.986-08	2.732-08	4.710-08	1.142-07	4.654-07	7.652-06	5.856-06	1.425-06	7.201-08	0.000
NO+	1.726-09	2.055-09	2.311-09	2.929-09	4.218-09	7.999-09	2.392-08	1.599-07	1.670-05	1.497-04	1.896-04	1.978-04	1.980-04
O+	6.818-14	9.344-14	1.154-13	1.763-13	3.361-13	1.021-12	6.393-12	1.284-10	1.022-07	1.556-06	1.671-06	1.503-06	1.486-06
O2+	1.216-16	1.683-16	2.093-16	3.251-16	6.396-16	2.086-15	1.555-14	4.863-13	2.195-09	2.343-07	5.402-07	7.272-07	7.407-07
O-	1.210-12	1.630-12	1.989-12	2.960-12	5.398-12	1.494-11	7.663-11	9.740-10	2.174-07	4.728-06	1.493-05	2.034-05	2.075-05

SURFACE SPECIES IS C*

CASE 1 - - - - - - - - - - - - STREAMWISE DIMENSION .41736-02 FEET - - - -24 OCT 69 15:49:51

ITERATED VALUES

ITS	TIME	ALPH	FPPW	DAMP	MAX.LIN ERROR		MAX.ERRORS IN CONSERVATION EQS. MOMENTUM		ENERGY		C3		CO		H		BN	
1	4.754	1.253	.5660	.4999	6.-08	13	-2.0-02	1	-8.9+01	1	-6.5-03	1	2.3-03	2	-0.0	2	-0.0	0
2	9.887	1.243	.5765	1.0000	2.-07	13	-9.6-03	1	-4.5+01	1	-3.2-03	1	1.1-03	2	-0.0	2	-0.0	0
3	15.018	1.243	.5759	1.0000	2.-07	11	3.5-04	9	5.6+00	8	-7.0-05	8	2.5-05	2	-0.0	2	-0.0	0
4	19.536	1.243	.5759	1.0000	6.-08	6	7.9-05	3	2.4-01	3	-1.3-05	3	4.4-06	2	-0.0	2	-0.0	0

ALPHA	XI (LB /SEC)**2	ROKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL (BTU/SEC SQ FT)	TOT ENTH	RERAD	QCOND
1.243+00	3.117-10	4.167-03	1.197+02	6.001+02	5.448-01	2.626+00	3.652+03	2.130+03	2.130+03	4.449+03

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	BORON	CARBON	NITROGEN	OXYGEN
3.994+01	0.000	0.000	4.886-01	4.886-01	-0.000	-0.000	-3.675-01	2.812-01	8.637-02

MOM TRANS COEFF. RHO*UE*CF/2	HEAT TRANS COEFF. RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, (RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	BORON	CARBON	NITROGEN	OXYGEN
2.141+00	1.519+00	0.000	3.216-01	3.216-01	-0.000	-0.000	1.484+00	1.484+00	1.484+00

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	BORON	CARBON	NITROGEN	OXYGEN
1.301-05	2.079-05	2.663-05	2.399-05	2.316+06	-0.000	-0.000	2.357-05	2.356-05	2.356-05

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	-1.861-01	0.000	5.759-01	3.994+01	3.116+03	6.979+02	4.070+01	3.116+03	8.157+03	1.033+13
5.166-07	2.984-02	-1.858-01	1.718-02	5.758-01	3.965+01	3.137+03	7.043+02	3.847+02	3.137+03	8.233+03	1.029+13
8.651-07	4.973-02	-1.854-01	2.863-02	5.757-01	3.946+01	3.151+03	7.087+02	5.478+01	3.151+03	8.286+03	1.025+13
1.570-06	8.951-02	-1.838-01	5.152-02	5.752-01	3.907+01	3.180+03	7.170+02	3.664+02	3.180+03	8.389+03	1.019+13
2.651-06	1.492-01	-1.797-01	8.583-02	5.742-01	3.847+01	3.223+03	7.298+02	6.110+01	3.223+03	8.551+03	1.009+13
4.516-06	2.487-01	-1.683-01	1.428-01	5.713-01	3.740+01	3.296+03	7.506+02	3.568+02	3.296+03	8.837+03	9.929+12
7.474-06	3.978-01	-1.406-01	2.276-01	5.641-01	3.567+01	3.411+03	7.794+02	2.932+01	3.411+03	9.328+03	9.664+12
1.177-05	5.968-01	-8.432-02	3.382-01	5.478-01	3.308+01	3.568+03	8.091+02	2.698+02	3.567+03	1.017+04	9.257+12
2.181-05	9.946-01	9.220-02	5.446-01	4.783-01	2.672+01	3.909+03	9.003+02	1.882+02	3.907+03	1.209+04	8.490+12
4.365-05	1.741+00	6.126-01	8.240-01	2.637-01	1.373+01	4.588+03	8.580+02	-3.016+02	4.583+03	1.266+04	8.295+12
6.650-05	2.487+00	1.282+00	9.500-01	9.760-02	4.895+00	5.121+03	5.408+02	-5.489+02	5.114+03	1.250+04	8.349+12
1.131-04	3.978+00	2.754+00	9.997-01	7.800-04	3.827-02	5.489+03	6.816+01	-8.464+01	5.482+03	1.235+04	8.398+12
1.633-04	6.216+00	4.992+00	1.000+00	0.000	0.000	5.520+03	0.000	2.373+01	5.513+03	1.234+04	8.402+12

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	5.892-01	6.399-05	1.416+00	3.369-01	3.016-05	7.149-01	7.352-01	2.888+01	0.000	0.000
5.168-07	5.729-01	6.436-05	1.406+00	3.367-01	3.032-05	7.146-01	7.353-01	2.879+01	0.000	2.516-03
8.651-07	5.680-01	6.462-05	1.400+00	3.365-01	3.044-05	7.144-01	7.353-01	2.872+01	0.000	4.174-03
1.570-06	5.585-01	6.512-05	1.387+00	3.362-01	3.066-05	7.140-01	7.354-01	2.860+01	0.000	7.447-03
2.651-06	5.443-01	6.590-05	1.368+00	3.356-01	3.100-05	7.134-01	7.355-01	2.841+01	0.000	1.224-02
4.516-06	5.212-01	6.726-05	1.337+00	3.347-01	3.160-05	7.124-01	7.358-01	2.811+01	0.000	1.989-02
7.474-06	4.865-01	6.960-05	1.291+00	3.330-01	3.260-05	7.109-01	7.361-01	2.770+01	0.000	3.050-02

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1.177-05  4.395-01  7.356-05  1.233+00  3.297-01  3.421-05  7.090-01  7.367-01  2.727+01  0.000      4.278-02
2.181-05  3.632-01  6.235-05  1.141+00  3.198-01  3.727-05  7.065-01  7.377-01  2.679+01  0.000      6.388-02
4.365-05  3.307-01  6.429-05  1.063+00  3.165-01  3.775-05  7.067-01  7.370-01  2.556+01  0.000      9.168-02
6.650-05  3.226-01  8.325-05  1.024+00  3.173-01  3.737-05  7.067-01  7.379-01  2.461+01  0.000      1.035-01
1.131-04  3.184-01  8.249-05  1.002+00  3.180-01  3.714-05  7.063-01  7.394-01  2.401+01  0.000      1.077-01
1.833-04  3.181-01  8.242-05  1.000+00  3.180-01  3.712-05  7.062-01  7.396-01  2.396+01  0.000      1.077-01

                                  DISTANCE FROM WALL,FT
           0.000     5.166-07  6.651-07  1.570-06  2.651-06  4.516-06  7.474-06  1.177-05  2.181-05  4.365-05
                6.650-05  1.131-04  1.833-04

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

   C3      1.150-01  1.125-01  1.108-01  1.073-01  1.020-01  9.290-02  7.869-02  5.874-02  1.551-02 -6.609-02
               -1.291-01 -1.727-01 -1.764-01
          -8.550-02 -8.635-02 -8.693-02 -8.807-02 -8.983-02 -9.282-02 -9.740-02 -1.035-01 -1.120-01 -1.014-01
               -6.387-02 -6.157-03  0.000
          -2.099-02 -3.586-02 -2.223-02 -3.537-02 -2.357-02 -3.643-02 -2.510-02 -3.569-02 -7.408-03  3.597-02
                6.458-02  1.011-02 -2.819-03
   CO      3.095-01  3.104-01  3.110-01  3.122-01  3.141-01  3.172-01  3.222-01  3.292-01  3.443-01  3.728-01
                3.948-01  4.101-01  4.114-01
           2.990-02  3.020-02  3.040-02  3.080-02  3.142-02  3.246-02  3.406-02  3.618-02  3.918-02  3.545-02
                2.234-02  2.853-03  0.000
           7.337-03  1.254-02  7.779-03  1.236-02  8.249-03  1.274-02  8.781-03  1.248-02  2.591-03 -1.258-02
               -2.259-02 -3.535-03  9.857-04
   H       0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
                0.000     0.000     0.000
           0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
                0.000     0.000     0.000
           0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
                0.000     0.000     0.000
   BN      0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
                0.000     0.000     0.000
           0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
                0.000     0.000     0.000
           0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
                0.000     0.000     0.000
   N2      5.755-01  5.771-01  5.783-01  5.805-01  5.840-01  5.899-01  5.991-01  6.121-01  6.402-01  6.933-01
                7.342-01  7.626-01  7.650-01
           5.560-02  5.615-02  5.653-02  5.727-02  5.842-02  6.036-02  6.334-02  6.727-02  7.285-02  6.592-02
                4.153-02  5.304-03 -0.000
           1.365-02  2.332-02  1.445-02  2.301-02  1.532-02  2.369-02  1.632-02  2.321-02  4.817-03 -2.339-02
               -4.200-02 -6.573-03  1.833-03

MOLE FRACTIONS

   C3      3.396-02  3.265-02  3.172-02  2.974-02  2.647-02  2.051-02  1.133-02  2.634-03  1.097-05  8.551-09
                7.203-11  1.051-14  0.000
   CO      3.191-01  3.190-01  3.189-01  3.187-01  3.185-01  3.183-01  3.185-01  3.202-01  3.161-01  1.934-01
                8.103-02  6.247-03  0.000
   H       0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
                0.000     0.000     0.000
   BN      0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
                0.000     0.000     0.000
   N2      5.398-01  5.405-01  5.409-01  5.419-01  5.432-01  5.453-01  5.493-01  5.583-01  5.771-01  5.846-01
                5.919-01  5.969-01  5.973-01
   E-      1.069-07  1.296-07  1.476-07  1.898-07  2.773-07  5.190-07  1.358-06  5.277-06  5.039-05  1.512-04
                1.759-04  1.790-04  1.789-04
   C+      0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
                0.000     0.000     0.000
```

BN*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	6.747-03	7.454-03	7.968-03	9.043-03	1.089-02	1.456-02	2.161-02	3.210-02	2.475-02	3.324-03	6.103-04	2.920-05	0.000
CH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CHN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CHO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CH2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CH3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CH4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CN	4.954-02	5.138-02	5.262-02	5.498-02	5.839-02	6.335-02	6.772-02	6.221-02	2.083-02	2.304-03	4.495-04	2.272-05	0.000
CO2	2.254-06	2.351-06	2.421-06	2.571-06	2.835-06	3.414-06	4.904-06	1.034-05	1.003-04	4.607-04	3.844-04	4.208-05	0.000
C2	1.475-02	1.550-02	1.600-02	1.692-02	1.820-02	1.974-02	1.977-02	1.350-02	1.001-03	1.092-05	4.221-07	1.097-09	0.000
C2H	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C2H2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C2N2	2.644-02	2.648-02	2.519-02	2.275-02	1.925-02	1.398-02	7.467-03	2.022-03	2.971-05	2.218-07	9.653-09	2.795-11	0.000
C3H	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C3H2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
HN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
HO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H2N	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H2O	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	6.575-04	7.416-04	8.046-04	9.423-04	1.197-03	1.789-03	3.370-03	8.689-03	4.704-02	7.093-02	6.395-02	5.798-02	5.746-02
NO	2.441-06	2.780-06	3.038-06	3.619-06	4.748-06	7.639-06	1.726-05	7.088-05	2.243-03	2.222-02	4.138-02	5.510-02	5.629-02
O	2.733-06	3.243-06	3.645-06	4.583-06	6.228-06	1.206-05	3.384-05	1.916-04	1.071-02	1.214-01	2.163-01	2.768-01	2.817-01
O2	6.643-11	8.241-11	9.553-11	1.279-10	2.017-10	4.510-10	1.829-09	2.185-08	1.196-05	1.013-03	3.599-03	6.546-03	6.847-03
C4	2.811-03	2.649-03	2.537-03	2.307-03	1.949-03	1.356-03	5.941-04	8.095-05	5.024-08	3.544-12	6.102-15	4.708-20	0.000
C5	4.176-03	3.654-03	3.325-03	2.732-03	1.967-03	1.027-03	2.697-04	1.409-05	6.202-10	3.317-15	1.224-18	5.224-25	0.000
B	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

BHO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BHO2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BH2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BH2O2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BH3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BH3O3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BO2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2H4O4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2H6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2O2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2O3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C+	9.297-08	1.132-07	1.292-07	1.669-07	2.451-07	4.615-07	1.208-06	4.546-06	2.185-05	2.631-06	3.173-07	1.162-08	0.000
N+	6.959-12	9.353-12	1.143-11	1.689-11	3.060-11	8.359-11	4.105-10	5.056-09	5.061-07	8.891-07	4.902-07	3.183-07	3.066-07
N2+	4.472-10	5.490-10	6.312-10	8.281-10	1.254-09	2.536-09	7.950-09	4.794-08	1.432-06	1.893-06	1.136-06	7.975-07	7.737-07
O2-	1.711-17	2.473-17	3.177-17	5.186-17	1.101-16	4.014-16	3.409-15	1.121-13	3.035-10	6.508-08	2.319-07	5.447-07	5.717-07
CO+	1.140-08	1.387-08	1.549-08	1.919-08	2.666-08	4.667-08	1.163-07	4.955-07	7.667-06	5.268-06	1.363-06	7.596-08	0.000
NO+	1.687-09	2.019-09	2.283-09	2.907-09	4.232-09	8.184-09	2.545-08	1.834-07	1.906-05	1.455-04	1.854-04	1.963-04	1.968-04
O+	6.269-14	8.671-14	1.081-13	1.666-13	3.237-13	1.015-12	6.757-12	1.507-10	1.159-07	1.429-06	1.586-06	1.479-06	1.465-06
O2+	1.147-16	1.602-16	2.013-16	3.154-16	6.331-16	2.140-15	1.713-14	6.123-13	2.816-09	2.302-07	5.264-07	7.191-07	7.344-07
O-	1.092-12	1.483-12	1.827-12	2.740-12	5.082-12	1.448-11	7.808-11	1.074-09	2.426-07	6.672-06	1.466-05	2.013-05	2.058-05

SURFACE SPECIES IS C*

CASE 1 - - - - - - - - - - - - STREAMWISE DIMENSION .83899-02 FEET - - - -24 OCT 69 15:50:11

ITERATED VALUES

ITS	TIME	ALPH	FPPW	DAMP	MAX.LIN ERROR		MAX.ERRORS IN CONSERVATION EQS. MOMENTUM		ENERGY		C3		CO		H		BN	
1	5.169	1.269	.5497	.4999	6.-08	13	4.9-02	1	4.9+01	1	3.7-03	1	-1.3-03	2	-0.0	2	-0.0	0
2	10.243	1.293	.5249	1.0000	7.-08	13	2.4-02	1	2.6+01	1	1.9-03	1	-6.7-04	2	-0.0	2	-0.0	0
3	15.340	1.293	.5252	1.0000	8.-08	13	-3.4-04	12	2.6+00	12	-1.8-04	12	6.3-05	2	-0.0	2	-0.0	0
4	19.886	1.293	.5252	1.0000	6.-08	13	1.9-05	11	4.8-02	10	-5.1-06	10	1.9-06	2	-0.0	2	-0.0	0

ALPHA	XI (LB /SEC)**2	RUKAP (FT)	PRESSURE (ATM)	EDGE VELOCITY (FT/SEC)	BETA	FLUX NOR-MALIZING PARAMETER	HEAT FLUXES DIFFUSIONAL	TOT ENTH (BTU/SEC SQ FT)	RERAD	QCOND
1.293+00	3.893-09	8.333-03	1.171+02	1.203+03	4.205-01	2.956+00	3.876+03	2.140+03	2.140+03	4.802+03

WALL SHEAR (LB/SQ FT)	MECH REM	MASS FLUXES PYROL GAS (LB/SEC SQ FT)	CHAR	TOTAL GAS	ELEMENTAL MASS DIFFUSIVE FLUXES (LB/SEC SQ FT) FOR HYDROGEN	BORON	CARBON	NITROGEN	OXYGEN
8.207+01	0.000	0.000	5.481-01	5.482-01	-0.000	-0.000	-4.106-01	3.141-01	9.648-02

MOM TRANS COEFF, RHO*UE*CF/2	HEAT TRANS COEFF, RHO*UE*CH	BLOWING PARAMETERS (BASED ON CH) FOR PYROL GAS	CHAR	TOTAL GAS	ELEMENTAL MASS TRANSFER COEFFICIENTS, RHOE*UE*CM (LB/SEC SQ FT) FOR HYDROGEN	BORON	CARBON	NITROGEN	OXYGEN
2.195+00	1.648+00	0.000	3.327-01	3.327-01	-0.000	-0.000	1.636+00	1.636+00	1.636+00

MOMENTUM THICKNESS, THETA (FT)	DISPLACE. THICKNESS, DELSTAR (FT)	EFFECTIVE BODY DISPLACE. (FT)	ENTHALPY THICKNESS, LAMBDA (FT)	REYNOLDS NUMBER PER FOOT	MASS THICKNESSES (FT) FOR HYDROGEN	BORON	CARBON	NITROGEN	OXYGEN
1.199-05	2.005-05	2.521-05	2.116-05	4.572+06	-0.000	-0.000	2.059-05	2.059-05	2.060-05

NODAL INFORMATION

DISTANCE, FROM WALL (FT)	ETA	F	FP (=U/UE)	FPP	SHEAR (LB/FTSQ)	TOTAL ENTH-HALPY,G (BTU/LB)	GP (BTU/LB)	GPP (BTU/LB)	STATIC ENTHALPY (BTU/LB)	TEMP (DEG R)	ELECTRON COLL FREQ (1/SEC)
0.000	0.000	-1.857-01	0.000	5.252-01	8.207+01	3.168+03	6.588+02	7.084+01	3.168+03	8.167+03	1.011+13
4.786-07	3.103-02	-1.854-01	1.631-02	5.259-01	8.160+01	3.188+03	6.650+02	3.289+02	3.188+03	8.243+03	1.006+13
8.010-07	5.172-02	-1.850-01	2.719-02	5.263-01	8.129+01	3.202+03	6.691+02	7.313+01	3.202+03	8.294+03	1.003+13
1.454-06	9.309-02	-1.834-01	4.897-02	5.269-01	8.064+01	3.230+03	6.775+02	3.298+02	3.230+03	8.398+03	9.970+12
2.455-06	1.552-01	-1.794-01	8.171-02	5.277-01	7.964+01	3.272+03	6.900+02	7.465+01	3.272+03	8.560+03	9.876+12
4.182-06	2.586-01	-1.681-01	1.363-01	5.280-01	7.786+01	3.344+03	7.106+02	3.232+02	3.344+03	8.846+03	9.715+12
6.923-06	4.137-01	-1.406-01	2.181-01	5.261-01	7.489+01	3.458+03	7.394+02	4.783+01	3.456+03	9.336+03	9.457+12
1.090-05	6.206-01	-8.426-02	3.261-01	5.173-01	7.028+01	3.613+03	7.696+02	2.444+02	3.610+03	1.018+04	9.057+12
2.022-05	1.034+00	9.388-02	5.313-01	4.637-01	5.822+01	3.951+03	8.621+02	2.027+02	3.943+03	1.211+04	8.302+12
4.049-05	1.810+00	6.275-01	8.187-01	2.646-01	3.097+01	4.630+03	8.212+02	-3.081+02	4.610+03	1.265+04	8.123+12
6.163-05	2.586+00	1.322+00	9.500-01	9.726-02	1.098+01	5.153+03	5.029+02	-5.125+02	5.127+03	1.246+04	8.184+12
1.046-04	4.137+00	2.854+00	1.000+00	-1.585-04	-1.754-02	5.496+03	5.402+01	-6.605+01	5.467+03	1.231+04	8.235+12
1.694-04	6.465+00	5.181+00	1.000+00	0.000	0.000	5.530+03	0.000	1.963+01	5.491+03	1.230+04	8.239+12

DISTANCE FROM WALL (FT)	DENSITY, RHO (LB/CU FT)	VISCOSITY, MU LB/SEC FT	RHO*MU /RHOE*MUE, C	SPECIFIC HEAT (BTU/LB R)	THERMAL COND (BTU /SEC FT R)	PRANDTL NUMBER	MODIFIED SCHMIDT NUMBER	MOLECULAR WEIGHT	RHOSQ*EPS /RHOE*MUE	MACH NUMBER
0.000	5.676-01	6.404-05	1.413+00	3.374-01	3.022-05	7.150-01	7.351-01	2.890+01	0.000	0.000
4.786-07	5.604-01	6.441-05	1.404+00	3.371-01	3.038-05	7.147-01	7.352-01	2.880+01	0.000	4.789-03
8.010-07	5.557-01	6.465-05	1.397+00	3.369-01	3.049-05	7.145-01	7.352-01	2.874+01	0.000	7.950-03
1.454-06	5.463-01	6.516-05	1.384+00	3.366-01	3.071-05	7.141-01	7.353-01	2.861+01	0.000	1.419-02
2.455-06	5.324-01	6.593-05	1.365+00	3.361-01	3.105-05	7.135-01	7.354-01	2.841+01	0.000	2.337-02
4.182-06	5.097-01	6.729-05	1.334+00	3.351-01	3.165-05	7.125-01	7.357-01	2.811+01	0.000	3.807-02
6.923-06	4.756-01	6.962-05	1.288+00	3.334-01	3.265-05	7.109-01	7.360-01	2.768+01	0.000	5.862-02

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1.090-05  4.293-01  7.360-05  1.229+00  3.300-01  3.426-05  7.089-01  7.367-01  2.724+01  0.000     8.265-02
2.022-05  3.542-01  8.245-05  1.136+00  3.199-01  3.734-05  7.064-01  7.376-01  2.675+01  0.000     1.248-01
4.049-05  3.233-01  8.424-05  1.059+00  3.166-01  3.773-05  7.067-01  7.370-01  2.550+01  0.000     1.825-01
6.163-05  3.162-01  8.303-05  1.022+00  3.174-01  3.731-05  7.067-01  7.380-01  2.457+01  0.000     2.076-01
1.046-04  3.128-01  8.231-05  1.001+00  3.180-01  3.706-05  7.063-01  7.395-01  2.401+01  0.000     2.165-01
1.694-04  3.126-01  8.226-05  1.000+00  3.181-01  3.705-05  7.062-01  7.396-01  2.397+01  0.000     2.163-01

                                  DISTANCE FROM WALL,FT
          0.000     4.786-07  8.010-07  1.454-06  2.455-06  4.182-06  6.923-06  1.090-05  2.022-05  4.049-05
              6.163-05  1.046-04  1.694-04

ELEMENTAL FRACTIONS AND THEIR FIRST AND SECOND DERIVATIVES WITH RESPECT TO ETA

    C3    1.189-01  1.162-01  1.144-01  1.108-01  1.053-01  9.595-02  8.125-02  6.058-02  1.584-02 -6.852-02
             -1.320-01 -1.734-01 -1.764-01
         -8.496-02 -8.582-02 -8.640-02 -8.757-02 -8.934-02 -9.235-02 -9.698-02 -1.031-01 -1.116-01 -9.982-02
             -6.579-02 -6.585-03  0.000
         -2.344-02 -3.191-02 -2.394-02 -3.239-02 -2.485-02 -3.339-02 -2.620-02 -3.266 [illegible]  466-03  3.877-02
              6.184-02  8.037-03 -2.378-03
    CO    3.381-01  3.091-01  3.097-01  3.110-01  3.129-01  3.162-01  3.213-01  3.285-01 [illegible]42-01  3.737-01
              3.959-01  4.104-01  4.114-01
          2.971-02  3.001-02  3.022-02  3.062-02  3.124-02  3.230-02  3.391-02  3.604-02  3.902-02  3.491-02
              2.126-02  2.303-03  0.000
          6.203-03  1.115-02  8.379-03  1.132-02  8.695-03  1.167-02  9.166-03  1.142-02  2.961-03 -1.356-02
             -2.163-02 -2.811-03  8.316-04
    H     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
              0.000     0.000     0.000
          0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
              0.000     0.000     0.000
          0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
              0.000     0.000     0.000
    BN    0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
              0.000     0.000     0.000
          0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
              0.000     0.000     0.000
          0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
              0.000     0.000     0.000
    N2    5.730-01  5.747-01  5.759-01  5.782-01  5.818-01  5.879-01  5.974-01  6.109-01  6.400-01  6.948-01
              7.361-01  7.631-01  7.650-01
          5.525-02  5.581-02  5.618-02  5.694-02  5.810-02  6.006-02  6.306-02  6.702-02  7.255-02  6.491-02
              3.953-02  4.282-03 -0.000
          1.523-02  2.076-02  1.556-02  2.107-02  1.615-02  2.172-02  1.703-02  2.124-02  5.505-03 -2.521-02
             -4.021-02 -5.226-03  1.546-03

MOLE FRACTIONS

    C3    3.550-02  3.413-02  3.315-02  3.107-02  2.766-02  2.143-02  1.185-02  2.740-03  1.094-05  7.273-09
              5.186-11  4.729-15  0.000
    CO    3.179-01  3.178-01  3.177-01  3.175-01  3.174-01  3.172-01  3.175-01  3.192-01  3.151-01  1.889-01
              7.596-02  4.960-03  0.000
    H     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
              0.000     0.000     0.000
    BN    0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
              0.000     0.000     0.000
    N2    5.369-01  5.376-01  5.381-01  5.390-01  5.403-01  5.425-01  5.466-01  5.558-01  5.752-01  5.843-01
              5.926-01  5.978-01  5.981-01
    E-    1.122-07  1.359-07  1.543-07  1.987-07  2.897-07  5.413-07  1.414-06  5.511-06  5.270-05  1.536-04
              1.748-04  1.758-04  1.757-04
    C*    0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
              0.000     0.000     0.000
```

BN*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	7.046-03	7.779-03	8.301-03	9.427-03	1.134-02	1.515-02	2.245-02	3.339-02	2.556-02	3.183-03	5.424-04	2.206-05	0.000
CH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CHN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CHO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CH2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CH3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CH4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CN	5.063-02	5.250-02	5.373-02	5.615-02	5.962-02	6.465-02	6.910-02	6.346-02	2.104-02	2.187-03	4.003-04	1.726-05	0.000
CO2	2.181-06	2.275-06	2.342-06	2.488-06	2.744-06	3.304-06	4.745-06	1.004-05	9.903-05	4.567-04	3.689-04	3.384-05	0.000
C2	1.545-02	1.622-02	1.673-02	1.770-02	1.902-02	2.062-02	2.064-02	1.408-02	1.019-03	9.852-06	3.364-07	6.369-10	0.000
C2H	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C2H2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C2N2	2.856-02	2.660-02	2.532-02	2.285-02	1.934-02	1.406-02	7.518-03	2.028-03	2.893-05	1.965-07	7.719-09	1.637-11	0.000
C3H	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C3H2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
HN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
HO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H2N	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H2O	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	6.728-04	7.585-04	8.214-04	9.629-04	1.222-03	1.824-03	3.432-03	8.877-03	4.845-02	7.140-02	6.313-02	5.694-02	5.651-02
NO	2.417-06	2.751-06	3.001-06	3.578-06	4.690-06	7.540-06	1.701-05	7.023-05	2.272-03	2.273-02	4.215-02	5.534-02	5.629-02
O	2.756-06	3.269-06	3.665-06	4.614-06	6.564-06	1.211-05	3.391-05	1.932-04	1.106-02	1.254-01	2.207-01	2.779-01	2.818-01
O2	6.510-11	8.071-11	9.329-11	1.251-10	1.970-10	4.398-10	1.779-09	2.145-08	1.223-05	1.062-03	3.759-03	6.658-03	6.903-03
C4	2.959-03	2.788-03	2.670-03	2.427-03	2.050-03	1.427-03	6.257-04	8.466-05	4.964-08	2.836-12	3.914-15	1.613-20	0.000
C5	4.395-03	3.846-03	3.503-03	2.876-03	2.072-03	1.082-03	2.838-04	1.473-05	6.019-10	2.501-15	7.071-19	1.381-25	0.000
B	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

BHO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BHO2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BH2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BH2O2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BH3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BH3O3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BO2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2H4O4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2H6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2O2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2O3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C+	9.805-08	1.192-07	1.357-07	1.755-07	2.573-07	4.835-07	1.263-06	4.773-06	2.318-05	2.509-06	2.732-07	8.499-09	0.000
N+	7.264-12	9.751-12	1.187-11	1.756-11	3.174-11	8.646-11	4.325-10	5.258-09	5.425-07	8.891-07	4.616-07	2.968-07	2.877-07
N2+	4.553-10	5.586-10	6.402-10	8.411-10	1.271-09	2.567-09	8.029-09	4.874-08	1.494-06	1.878-06	1.078-06	7.521-07	7.334-07
O2-	1.714-17	2.473-17	3.161-17	5.173-17	1.095-16	3.981-16	3.367-15	1.120-13	3.149-10	6.802-08	2.394-07	5.394-07	[illegible].605-07
CO+	1.197-08	1.406-08	1.566-08	1.943-08	2.695-08	4.712-08	1.172-07	5.023-07	7.940-06	5.112-06	1.222-06	5.742-08	0.000
NO+	1.677-09	2.005-09	2.261-09	2.884-09	4.193-09	8.096-09	2.513-08	1.825-07	1.967-05	1.485-04	1.347-04	1.929-04	1.932-04
O+	6.432-14	8.884-14	1.103-13	1.703-13	3.300-13	1.032-12	6.843-12	1.543-10	1.241-07	1.467-06	1.550-06	1.416-06	1.405-06
O2+	1.138-16	1.588-16	1.986-16	3.120-16	6.246-16	2.106-15	1.679-14	6.081-13	2.968-09	2.402-07	5.305-07	7.040-07	7.156-07
O-	1.123-12	1.524-12	1.868-12	2.808-12	5.196-12	1.476-11	7.933-11	1.100-09	2.538-07	6.872-06	1.473-05	1.974-05	2.008-05

SURFACE SPECIES IS C.

SECTION VI

POTENTIAL PROBLEM AREAS

1. DISCUSSION

The integral matrix procedure which is used to solve the boundary layer equations uses general Newton-Raphson iteration, as does the chemistry solution procedure. In this iteration process the derivatives of all equations with respect to the primary dependent variables are employed to drive the errors toward zero. The boundary layer equations converge very rapidly (3 or 4 iterations) when chemistry is not taken into account but the chemistry equations themselves are very nonlinear and, furthermore, can cause the boundary layer equations to become very nonlinear. Therefore, it has been necessary to develop extensive convergence damping procedures for both the chemistry and boundary layer iteration procedures. These have proven generally to be quite satisfactory, but difficulties are sometimes encountered for very severe problems. The types of problems which can occur, the symptoms of these problems, and procedures for coping with the problems are discussed in this section. The subject of possible program errors and debug output useful for tracing any such errors is discussed later in this section.

An unsuccessful solution usually manifests itself as a nonconvergent chemistry or a nonconvergent boundary layer. Often a nonconvergent chemistry is not the result of an inadequacy or programming error in the chemistry routines (EQUIL and its subroutines) but is traceable to one of the following: (1) an excursion has occurred during the boundary layer iteration such that the chemistry routines have been called upon to solve an impossible problem, or (2) a bad chemistry data deck has been employed. The latter could be bad thermochemical property data (e.g., curve fits which produce negative C_p) or a poor choice of species (e.g., omission of a species important to the solution). These types of considerations should be investigated first if a nonconvergent chemistry occurs.

On occasion when the equations are particularly nonlinear, the chemistry iteration can get temporarily trapped away from the solution. A very elaborate rescue procedure ensues which usually overcomes the difficulty but, sometimes, not within the allowed number of chemistry iterations. If a chemistry solution is nearly converged, recovery may be possible. For this reason, the boundary layer iteration is allowed to proceed with a notation in the output that a nonconvergent chemistry has occurred. If no nonconvergent chemistries occur in the iteration just preceding a converged boundary layer solution, any prior chemistry nonconvergences can be disregarded. On the other hand, if a chemistry solution

is far from convergent, it may produce a fatal error in a subsequent chemistry or boundary layer iteration. In any event a STOP is encountered after 20 nonconvergent chemistry solutions accumulate in the current case.

When a problem initiates during a boundary layer iteration, the first symptom often shows up as a nonconvergent chemistry (as mentioned previously). Again, this is usually the result of bad input data or a poorly posed problem. Occasionally, however, the boundary layer will not converge in the allowed number of iterations. Some recovery procedures have been developed into the boundary layer iteration but these are not as elaborate as those for the chemistry iteration. If this happens and it appears that the input data are all correct, it sometimes helps to rearrange boundary layer nodal spacing, especially for highly blown boundary layers. If this also fails, it may be that the problem is too severe for the iteration procedure.

If the user is considering unequal diffusion coefficients, he should then revert to assumed equal diffusion coefficients since the derivatives used in the convergence process (these do not affect the final answer as the solution converges) are less exact in unequal diffusion problems. Also, one could set up a sequence of subcases leading up to the problem of actual interest.

Lest the reader become frightened by these prospects, it should be emphasized that the convergence procedures employed in the chemistry and boundary layer iterations are nearly 100 percent reliable for most problems and get into difficulties only occasionally and then only for problems with massive blowing (say where the boundary layer gas in the vicinity of the wall consists of about 99 percent or more of gas injected from the wall) and for unequal diffusion problems where the unequal diffusion effects are very strong.

It is, of course, possible that a bug in the program has actually caused a problem. It is thus pertinent to review the operational status of the program. The BLIMP program has been used extensively over the last three years. During this time the number of boundary layer solutions which have been obtained probably exceeds one thousand, while the number of chemistry solutions (required at each boundary layer nodal point and for each boundary layer iteration) is probably well in excess of one hundred thousand. The recent addition of a turbulent model has indeed perturbed the size and some of the fluid mechanical aspects of the code, however these changes are largely confined to the TREMBL subroutine. The more complicated chemistry portions of the program have remained untouched and therefore debugged for the most part. A large number of check cases have thoroughly exercised the new turbulent and transiton model logic, therefore this portion of the program also should be error-free. In view of the size of the program and its enormous number of options, however, it is possible that some errors may still exist for some combinations of these options. For this reason an elaborate system of debug write statements has been retained in the program.

Debug output is obtained by setting KR(15) through KR(20) to nonzero values. The output obtained with the various KR options is summarized in Section III and described in detail in the remainder of this section. The ambitious and sophisticated user should be able to track down any such error with the use of this debug output and the information presented in this manual.

2. DEBUG OUTPUT FOR BLIMP

TIME OF CALL	CONDITION	DO LOOP	WRITE LIST	FORMAT	NO.
LINMAT BEFORE BA1 MATRIX INVERSION	KR(15) GT 1		MAT1I,MAT1J	2I3	01
	KR(15) GT 1	I=1,MAT1I	(BA1(I,J),J=1,MAT1J)	12E10.3	02
LINMAT AFTER BA1 MATRIX INVERSION	KR(15) GT 1	I=1,MAT1I	(BA1(I,J),J=1,MAT1J)	12E10.3	03
LINMAT BEFORE BA2 MATRIX INVERSION	KR(15) GT 1		MAT2I,MAT2J	2I3	04
	KR(15) GT 1	I=1,MAT2I	(BA2(I,J),J=1,MAT2J)	12E10.3	05
LINMAT AFTER BA2 MATRIX INVERSION	KR(15) GT 1	I=1,MAT2I	(BA2(I,J),J=1,MAT2J)	12E10.3	06
LINMAT AFTER GENERATION OF LAR	KR(15) GT 1		LAR	20I4	07
FIRSTG AFTER CALC-ULATION OF FIRST GUESSES	KR(15) NE 0		((F(I,J),J=1,NETA),I= 1,4),(((SP(I,J,K-1), J=1,NETA),I=1,3),K=1, NSP)	7E10.3	08
EQUIL DURING EDGE EXPANSION	KQ(7) GT 1 KR(7)=0		T,P,WM	F10.4,F8.4, F11.7	09
	KQ(7) GT 1 KR(7)=0		W	3E12.5	10
	KQ(7) GT 1 KR(7)=0		HIP,SIP,RHR	E14.7,E12 .5,E13.6	11
	KQ(7) GT 1 KR(7)=0		(FAMOA(I),FAMOB(I),VN (I),DY(I),Y(I),VLNK (I),IFC(I),E(I),CP(I) ,I=1,N)	2A4,4E13.5 ,I5,2E13.5	12
EQUIL DURING EDGE EXPANSION	KQ(7) NE 0 KR(7)=0		ITS,EL,ENL,T,AAA	I5,4F15.9	13

TIME OF CALL	CONDITION	DO LOOP	WRITE LIST	FORMAT	NO.
EQUIL DURING EDGE EXPANSION FOR NONCONVERGENT CHEMISTRY	IF ITS GT 50(PERMIT-TED NO OF ITERATIONS) OR SINGU-LAR MATRIX (KR(7)=0)		ISS,ITEM,II,MITS,ITS, IQQ,HIP,SIP,TT(II),ALP ,LEF,(FR(I,II),I=1,N) (ALSO, IG IS SET TO -2 AND KR(7) TO 1 TO PRO-DUCE ADDITIONAL OUTPUT	6I5,3E12.5 /6E12.5,6 I4/(10E11 .4))	14
RERAY FOR CHEMISTRY INVERSION DURING EDGE EXPANSION (CALL FROM EQUIL)	KQ(7) GT1 KR(7)=0		RERAY PACKAGE(N=IN,C=APE (IL,IL),NN=0,D=B(IL), NNN=1,LS=0,IS=IG,ND=10)		15
CRECT DURING EDGE EXPANSION	KQ(7) GT 1 KR(7)=0		(VN(I),Y(I),DY(I),CMFF (I),FM(I),I=1,N)	4E12.4,I5, 4E12.4,I5	16
	KQ(7) GT 1 KR(7)=0		(EB(I),I=1,IS)	8E12.4	17
	KQ(7) GT 1 KR(7)=0		(X(I),I=1,INP)	8E12.4	18
	KQ(7) GT 1 KR(7)=0		(IB(I),I=1,IS)	10I5	19
REPEAT 9 THROUGH 19 FOR EACH CHEMISTRY ITERATION, ITS = -1 INDICATES CONVERGED SOLUTION (SEE 13), 16,17,18 AND 19 ARE NOT PRINTED ON CONVERGED SOLUTION. 21 THROUGH 25 ARE THEN PRINTED FOR CONVERGED EDGE SOLUTION. THE NUMBER OF CHEMISTRY ITERATIONS FOR WHICH THIS DETAILED INFORMATION IS PRINTED IS KR(18)*5-4. FOR LATER ITERATIONS THERE IS ONE-LINE-OUTPUT PER CHEMISTRY ITERATION (GIVEN BY 13) AND THE STANDARD CHEMISTRY OUTPUT PACKAGE IS EMPLOYED FOR THE CONVERGED SOLUTION.					20
EQUIL DURING EDGE EXPANSION	KQ(7) GT 1 KR(7)=0		CPF,CSP,ALF,BETH,GAM	5E12.5	21
REPEAT 9, 10 AND 11 FOR CONVERGED SOLUTION					22
EQUIL DURING EDGE EXPANSION	KQ(7) GT 1 KR(7)=0		VEL,VMACH,AREA	3E10.3	23
REPEAT 12 FOR CONVERGED SOLUTION					24
REFCON AFTER CALL OF EQUIL	KR(15) NE 0	IS=1,NS	IS,HE,UE(IS),PTE(IS,1) ,TE(IS),RHOE(IS), VMUE(IS)	I3,6E10.3	25

TIME OF CALL	CONDITION	DO LOOP	WRITE LIST	FORMAT	NO.
HISTXI BEFORE RETURN	KR(17) NE 0		IS,DLX1,DLX2,DZ,D1,D2, ALPHD,HALPH,C1,C2,C4, GD,((ZM(I,J),J=1,6),I =1,4),((ZG(I,J),J=1, 6),I=1,4),((HF(I,J), J=1,5),I=1,7),((HG(I, J),J=1,3),I=1,7)	6XI2/8X1LE 10.3/8X8E 10.3/(8X 10E10.3)	26
	KR(17) NE 0 NSPM1 NE 0		(((ZSP(I,J,K),K=1, NSPM1),J=1,6),I=1,4), (((HSP(I,J,K),K=1, NSPM1),J=1,3),I=1,7)	10E10.3	27
PERFORM 20 FOR CHEMISTRY SOLUTION IN BOUNDARY LAYER FOR II=1 (WALL), INSERTING 28, 29 AND 30 BETWEEN 15 AND 21 FOR CONVERGED SOLUTION ONLY (23 NOT PRINTED FOR BOUNDARY LAYER SOLUTIONS)					28
PROPS DURING BOUNDARY LAYER CALCULATION FOR II=1 (WALL)	KR(20) NE 0 KR(7)=0		OMEGA,DBAR,VLAM,SC(II), PR(II),VMU1,VMU2,VMU3, TT(II),VMU5,VMU6,FF(1) ,FF(2),FF(3),CPTIL, HTIL,(VK(I),WTM(I),ZK (I),I=1,ISM),VMU(II)	8E12.4	29
PROPS DURING BOUNDARY LAYER CALCULATION FOR II=1 (WALL)	KR(20) NE 0 KR(7)=0		DMU3H,DMU3K,DMU4H, DMU4K,DHTILH,DHTILK, DTH,DTK,DRHOH,DRHOK, DZKH,DZKK,HG,VK,RMMG	8E12.4	30
NONCER DURING BOUNDARY LAYER CALCULATION FOR I=1, WALL	KR(17) GT 0		C1,C2,C3,C4,COEEQV, COEFQV	12E10.3	31
IMONE DURING BOUNDARY LAYER CALCULATION FOR I=2	KR(17) GT 0		RRR,I	7E10.4,I5	32
	KR(17) GT 0		QQQ,I	7E10.4,I5	33
	KR(17) AND NSPM1 GT 0	K=1,NSPM1	(SSS(L,K),L=1,7),I	7E10.4,I5	34
PERFORM 28 EXCEPT FOR II=2					35
IONLY DURING BOUNDARY LAYER CALCULATION FOR I=2	KR(17) GT 0		RRR,I	7E10.4,I5	36

TIME OF CALL	CONDITION	DO LOOP	WRITE LIST	FORMAT	NO.
	KR(17) GT 0		QQQ,I	7E10.4,I5	37
	KR(17) AND NSPM1 GT 0	K=1,NSPM1	(SSS(L,K),L=1,7),I	7E10.4,I5	38
REPEAT 31					39
REPEAT 32 THROUGH 39 FOR EACH BOUNDARY LATER NODAL POINT UNTIL I = NETA (BOUNDARY LAYER EDGE)					40
NONCER JUST BEFORE MATRIX INVERSION	KR(19) GT 0		FNLE,GNLE	11E10.3/ (10E10.3)	41
	KR(19) AND NSPM1 GT 0		((SPNLE(I,K),K=1,NSPM1) ,I=1,MAT2J)	11E10.3/ (10E10.3)	42
RERAY FOR BOUNDARY LAYER INVERSION (CALL FROM NONCER)	KR(17) GT 0		RERAY PACKAGE(N=NAM,C=AM ,NN=NSP+1,D=ENL,NNN=1, LS=LAR,IS=IX,ND=45)		43
NONCER JUST AFTER MATRIX INVERSION	KR(17) GT 0		FLE,GLE	11E10.3	44
	KR(17) AND NSPM1 GT 0		((SPLE(I,K),K=1,NSPM1), I=1,MAT2I)	11E10.3	45
NONCER BEFORE MATRIX INVERSION FOR WALL RELATIONS	KR(16) GT 1 KR(17) GT 0		((DQJNL(I,K),K=1,NSP), I=1,NNLEQ)	10E10.3	46
NONCER JUST BEFORE MATRIX INVERSION FOR WALL RELATIONS	KR(16) GT 0		((DQJRNL(I,K),K=1,NSP), I=1,NRNL),DELQW,DELJW, WALLQ,WALLJ	10E10.3	47
REPEAT 9 THROUGH 19 FOR EACH SURFACE CHEMISTRY ITERATION UNTIL ITS EQUALS KR(18)*5-4 OR (KR(16)-1)*5 FOR KR(11)=2 PROBLEMS. FOR LATER ITERATIONS THERE IS ONE-LINE-OUTPUT PER CHEMISTRY ITERATION (GIVEN BY 13) AND THE STANDARD CHEMISTRY OUTPUT PACKAGE IS EMPLOYED FOR THE CONVERGED SOLUTION SUPPLEMENTED BY THE NAME OF THE SURFACE SPECIES.					48
RERAY FOR INVERSION OF WALL RELATIONS, SURFACE EQUILIBRIUM OR KINETIC SOLUTIONS (CALL FROM NONCER)	KR(16) GT 0 KR(11)=2		RERAY PACKAGE(N=NRNL-II ,C=AM(II+1,II+4),NN=0, D=DRNL(II+1),NNN=1,LS= 0,IS=IXX,ND=45)		49
NONCER JUST BEFORE CORRECTING PRIMARY VARIABLES	KR(17) OR KR(19) GT 0		DRNL	11E10.3	50

TIME OF CALL	CONDITION	DO LOOP	WRITE LIST	FORMAT	NO.
	KR(17) OR KR(19) GT 0		DVNL	11E10.3	51
	KR(17) OR KR(19) GT 0		FLE,GLE	11E10.3	52
	KR(17) OR KR(19) GT 0 AND NSPM1 GT 0		((SPLE(I,K),K=1,NSPM1), I=1,MAT2I	11E10.3	53
ITERAT AT END OF CURRENT BOUNDARY LAYER ITERATION	ALWAYS		ITS ALPH FPPW,EASE,ELMM ,IFNLM,FNLEM,IGNLM, GNLEM,(ISPNLM(K), SPNLEM(K),K=1,NSPM1)	I9,F6.3, F7.4,F6.4 ,E7.0,8 (I3,E8.1)	54
OUTPUT AT END OF CURRENT BOUNDARY LAYER ITERATION	KR(4)=1		STANDARD BOUNDARY LAYER OUTPUT PACKAGE		55
REPEAT 28 THROUGH 55 FOR SUCCEEDING BOUNDARY LAYER ITERATIONS					56
RERAY DEBUG PACKAGE THE RERAY CALL LIST IS (N,C,NN,D,NNN, LS,IS,ND) THE DEBUG TEST VARIABLE IS IS ASSIGNED THE VALUE OF -1 BEFORE RETURN	IS=-2		NP,NNN,N	(15H ((C(I,J),J=1, I3,12H),(D(J),J=1, I3,6H),I= 1,I3,15H) BEFORE RERAY)	
	IS=-2		NP,(L(I),I=1,NP)	(11H L(I) ,I=1,I3,5 X (30I3))	
	IS=-2	I=1,N	(C(I,J),J=1,NP), (D(I,J),J=1,NNN)	11E10.3/ (10E10.3)	
	SINGULAR MATRIX (RETURN AFTER PRINTING)		(II,L(II),SD(II),II= 1,I) WHERE I IS INDEX IN DO LOOP RUNNING TO N	(24H PIVOT ROW/COL/ RES.RATIO 5(I4,1H/I 3,1H/E9.2 ,1H,))	
	IS=-2		(I,L(I),SD(I),I=1,NP)	SAME AS ABOVE	

TIME OF CALL	CONDITION	DO LOOP	WRITE LIST	FORMAT	NO.
	IS=-2		NP,NNN,N	(15H ((C(I,J),J=1, I3,12H),(D(J),J=1, I3,6H),I= 1,I3,14H) AFTER R ERAY)	
	IS=-2	I=1,N	(C(I,J),J=1,NP), (D(I,J),J=1,NNN)	1IE10.3/ (10E10.3)	

SECTION VII

OPERATING PROCEDURES

This program is written in FORTRAN V source language for the CDC 6600, with a 130 K core, or a computer of similar configuration. Conventional formatted READ statements are used for input data. Card input and tabular output are on tape units KIN and KOUT, respectively, defined in the main routines (BLIMP or CABLE) as 5 and 6, respectively (KOUT is also defined in subroutine RERAY). Two scratch tapes, NBT and NBT2 are required for temporary storage of data needed for multi-case or multi-time solutions. These are assigned the numbers 13 or 14, respectively, in subroutine SETUP. For CABLE runs these tapes plus tape 12 should be saved for restarting purposes.

SECTION VIII

PROGRAM DIMENSIONING

The dependence of the variable dimensions within the program on the basic system dimensions is of key importance for those users desiring to make program modifications. Changes of system dimensions result not only in redimensioning of program variables but also changes in certain program instructions. A generalized technique for dealing with these dimension changes is presented below.

The technique which is used consists of presenting the list of program COMMONS and DIMENSIONS in general form, with a key to the general terminology used. The following definitions apply:

COM	=	number of components (≡7; 1 edge, 3 pyrolysis gas, 3 char)
NSP	=	number of elements (exclusive of electron)
NETA	=	number of η values (surface normal grid)
NS	=	number of streamwise stations
MOL	=	number of molecules
NCON	=	number of simultaneously failing surface condensed species +1
NITEM	=	number of times or cases
NKIN	=	number of kinetic reactions
NDISC	=	number of discontinuities which may be flagged

The following code will be used

*A	=	CØM
*B	=	NSP-1
*C	=	NSP
*D	=	NETA-1
*E	=	NSP+1
*F	=	NETA
*G	=	NSP+2
*H	=	NETA+3
*I	=	NSP + NCØN+3
*J	=	2*NETA
*K	=	3*NETA-2
*L	=	NS
*M	=	NKIN
*N	=	NSP+3
*Ø	=	NCØN
*P	=	NDISC+1

```
**A  =  19+NETA*(2*NSP+6)
**M  =  MØL+1
**N  =  NETA*(NSP+1)+3
**Ø  =  NITEM
**P  =  NETA*(2*NSP+3)-2
**Q  =  3*NS+5+NETA*(5+3*NSP)
**R  =  NS*(NSP+6)+7
**S  =  NETA*(7+3*NSP)+1
**T  =  4*(NSP+1)*(NETA-1)+6
**U  =  NS*(NSP+6)
**V  =  MØL+2
**W  =  MØL+4
**X  =  NSP*(3*NSP+21)-9
**Z  =  (NSP+1)*(NETA-2)-4/NPS-6
```

In the terminology of this code, Listing No. 1 at the end of this section describes the basic set of COMMON statements with the appropriate dimensions. Certain COMMONS must be modified for use in the set of chemistry routines (EQUIL, THERM, MATER, CRECT, INPUT, PROPS, and KINET) because of variable name anomalies. These COMMONS are shown in Listing No. 2.

Listing No. 3 indicates the common blocks required by each routine. Excluded from this list are truncated common blocks which are required for certain routines. In those cases where truncation results in a dimensionally independent COMMON, no reference is necessary. If it is dimensionally dependent, it is included on Listing No. 4 together with all dimension, equivalence and program statements which are affected by changes in system dimension. Each entry in this last table is identified by routine and approximate line location within that routine and can easily be located with respect to a current listing.

LISTING NUMBER 1

STANDARD COMMONS FOR ALL ROUTINES EXCEPT WHERE ALTERNATES ARE INDICATED

```
      COMMON/BLQCOM/  MOA(**M),  MOB(**M),NSPEC,FR(**M,*F),W(3),LEF(*E)
     1,LEFS(*E),PIEASE,LEFW(*E)
      COMMON/BUMCOM/    BUMP,CORMA,EASE,ICORM,WDOT,TFZ,I777,DTEMP,KIP,IX
      COMMON/COECOM/                 C5,C6,C7,C8,C9,C10,C11,C12,C13,C14,C15
     1,C16,C17,C18,C19,C20,C21,C22,C23,C24,C25,C26,C27,C28,C29,C30,C31,C
     232,C33,C34,C35,C36,C37,C38,C39,C40,C41,C42,C43,C44,C45,C46,C47,C48
     3,C49,C50,C51,C52,C53,C54,C55,C56,C57,C58,C59,C60,C61,C62,C63,C64,C
     465,C66,C67,C68,C69,C70,C71,C72,C73,C74,C75,C76,C77,C78,C79,C80,C81
     5,C82,C83,C84,C85,C86,C87,C88
      COMMON/COECON/ CK1(*B),CK2(*B),CK3(*B),CK4(*B),CK5(*B),CK6(*B)
     1,CK7(*B),CK8(*B),CK9(*B),CK10(*B),CK11(*B),CK12(*B),CK13(*B)
     2,CK14(*B),CK15(*B),CK16(*B),CK17(*B),CK18(*B),CK19(*B),CK20(*B)
     3,CK21(*B),CK22(*B),CKK1(*B,*B),CKK2(*B,*B),XM(5),XG(5),XSP(5,*C)
     4,CKK3(*B,*B)
      COMMON/CRBCOM/HCARB,EMIS,STEF,ADUM,BDUM,CDUM,HTEF,HMAT,EMISC,EMIST
     1,HPG,ASU(3),BSU(3),HPYG(3),HCHAR(3),EMIV(3),KS(*L),ISU
      COMMON/EDGCOM/             PE(*L, 1),PTE(*L, 1),SPE(*B,*L, 1),DUES,
     1UE(*L),RHOE(*L),VMUE(*L),TE(*L),UEDGE,DUEDGE,D2UEDG,VMWE,HE,C90
     2 ,DSIP(*L),IDSIP,TTVC,TVCC(*L)
      COMMON/EPSCOM/ELCON,YAP,CLNUM,SCT,PRT,RED,DVS,RHOVS,PI,PIM,CL,
     1EPSA(*F),EPS1,EL(*F),DPI(*F,2),DLI(**N),DEPS(**N),DEPC,TREF,RETR
      COMMON/EQPCOM/  RB(**M,2),RC(**M,2),RD(**M,2),RE(**M,2),RF(**M,2),
     1 TU(**M,2),FF(**M),FFA,IFC(**M),ATA(*E),ATB(*E),ATC(*E),WAT(*E),
     2KAT(*E),IR(*E),IZ,KZ(10),LAMI(**M),P,Z,TK(*E,*A),VN(**M),
     3 VNU(**M,*E),ITFF,KR2,HCH,NCV,WM,WTM(**M),YYY(**M),YW(**M),GG(**M)
     4 ,7Q(*E,*A),EPOVRK,SIGMA,BASMOL
      COMMON/EQTCOM/SIP,HIP,EEL,EENL,FLIQ,CPF,IRE,IER,AA,IITS,IN,IL,IIT,
     1 MODE,HMELT,SMELT,TMAX,TMIN,MELT,SUMN,SUML,WS,WSS,BX,ISP2,ISPQ,
     2 ISP,KKJ,SVA,SVB,SVC,SVD,SUMC,FFF,CMF,EP,RV,IFCJC,WTG,WTL,JC,HHG,
     3 CCPG,TTMIN,TTMAX,L2,L3,IB(*G),EB(*E),EBL(*E),A(*I,*I),BB(*I),
     4 IP(**M),ALP(*E),FNU(*E),GAMH(*E),GAMF(*E),SLAM(*E),DY(**M),RVS,
     5 CP(**M),HH(**M),SB(**M),TC(**M),VLNK(**M),E(**M),PNUS(*E),
     6 BC(*E),BLNK(*E),BY(*E),IBC(*E),BE(*E),JZ(*O)
      COMMON/ERRCOM/FLE( *K),GLE(*J),SPLE(*J,*B),ELA(**P),FLEM,GLEM
     1,SPLEM(*B),ELM(*D),ELMM,IFLM,IGLM,ISPLM(*B),NELM,ILMM,DFL(*K)
     2,DGL(*J),DSPL(*J,*B),FNLE(*H),GNLE(*F),SPNLE(*F,*B),ENL(**N)
     3,FNLEM,GNLEM,SPNLEM(*B),          ENLMM,IFNLM,IGNLM,ISPNLM(*B)
     4,NENLM,INLMM,DFNL(*H),DGNL(*F),DSPNL(*F,*B),DRNL(*E)
      COMMON/ETACOM/ETA(*F),DETA(*F),DSQ(*D),DCU(*D),B1(*D),B2(*D)
     1,LAR(**N),BA1(*K,*H),BA2(*J,*F)
      COMMON/FLPCOM/TXI(2),TUE(2),TRHOE(2),TTE(2),TVMUE(2),TMAT(**T,2)
     2,THF(*F,2),LEFT(*E,2),TPE(2),TRADS(2),TDSIP(2),KQT(2)
      COMMON/FLXCOM/DELQW,DELJW(*B),DQNL(**N),DJNL(**N,*B),WALLQ
     1,WALLJ(*B),QW,VJKW(*C),TPWALL
      COMMON/HISCOM/C1,C2,C3,C4,ALPHD,BETA,ZM(4,*D),ZG(4,*D),ZSP(4,*D,*B
     1 ),XI(*L),HF(*F,5),HG(*F,3),HSP(*F,3,*B),HALPH,HUE,HHUE,HFW,DLX2
```

```
2,C3M(*L),BETAM(*L)
 COMMON/INTCOM/ KR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,I,IS,N
1S,IT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL, ITS,KAPPA,CBAR,CASE(15)
2,B(8),      MWE,NON,KQ(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,KR9(*L)
3,KAUXO,JTIME,JSPEC,MD(3)
 COMMON/KINCOM/MT,FKF(*M),EAK(*M),EXK(*M),PMU(*E,*M),RMU(*E,*M),
1 DKPT(*M),PKP(*M),PKR(*M),RAT(*M),RSIG(*M),MA(*M),LL(*M),PMR(*M),
2 PRMU(*E,*M),EESE(*E)
 COMMON/NONCOM/AM(**N,**N),DVNL(**N),TCW,
1VLNKW,DLPH(*C),DLPK(*B,*C),DTHW,DTKW(*B),FLUXJB(*C)
 COMMON/OUTCOM/Y(*F),RES,DELST,THENGY,THMOM,CH,BLOW,SHEAR,CF,SHAPE
1 ,CM(*C),THELEM(*C)
 COMMON/PRMCOM/TIME(**O),PRE(*L),PTET(**O),GE(**O),S(*L),ROKAP(*L)
1,RNOSE,VKAP,NDISC,IDISC(*L),NSD(*P),MSD(*P),ITF(**O),IPRE,RADNO,
2CONE,RADFL(**O),RADR(*L),RADS(*L),IRAD
 COMMON/PRPCOM/PR(*F),T(*F),RHO(*F),SC(*F),CAPC(*F),QR(*F),H(*F)
1,CPBAR(*F),VMW(*F),PHIK(*F,*B),DRHOH,DRHOK(*B),ZK(*B),DZKH(*B),   D
2MU3K(*B),DMU4K(*B),DTK(*B),DPHIKH(*B),DPRK(*B),DSCK(*B),DCAPCK(*B)
3,DHTILK(*B),DQRK(*B),DCPBK(*B),DCPTK(*B),DMU12K(*B),DZKK(*B,*B)
4,DPHIKK(*B,*B),      DMU4H,DMU3H,DHTILH,VMU12,CT,CTR,CPTIL,HTIL
5,VMU3,DTH,DCAPCH,DPRH,DSCH,DQRH,DCPBH,DCPTH,DMU12H,VMU(*F),   RHOP
6(*F),PHIKP(*F),HP,TP,ZKP(*B),VMU3P,VMU4P,HTILP,CRHO(*D),GMR(*F)
 COMMON/STTCOM/GAM1,PRDUM,PRA,PRB,PRC,PRD,VMUA,VMUB,VMUC,VMUD,NC,
1 FLD(6,3),VMWD
 COMMON/TEMCOM/SPDUM(*B),DER(*L),DUMM1(*F),SLOPE(*F),REDUM(*F)
1,SDUM1(*L),SDUM2(*L),FWDUM(*L),XICON(*L),FWCON(*L),FWINIT( 1)
2,XIINIT( 1),DUDS( *L)
 COMMON/VARCOM/F(4,*F),G(3,*F),SP(3,*F,*C),ALPH
 COMMON/WALCOM/FW(*L, 1),TW(*L, 1),HW(*L, 1),SPW(*B,*L, 1)
1,RHOVW(*L, 1),FLUXJ( 3,*L, 1),IHW,ITW,IFW,ISPW,IRHOVW,IFLUXJ
```

LISTING NUMBER 2

THE FOLLOWING COMMONS SHOULD BE USED IN B20A THROUGH B25A AND B28A

```
 COMMON /INTCOM/KKR(20),KIN,KOUT,MAT1I,MAT2I,MAT1J,MAT2J,NETA,II,
1ISS,NS,ITT,NTIME,NSP,NSPM1,NAM,NLEQ,NNLEQ,NRNL,MITS,KAPPA,CBAR,
2CASE(15),BB(8),  MWE,NON,KD(10),ITEM,NITEM,KR17,NBT,NBT2,IDENT,
3 KR9(*L),KAUXO,JTIME,JSPEC,MD(3)
 COMMON /PRPCOM/PR(*F),TT(*F),RHO(*F),SC(*F),CAPC(*F),QR(*F),HH(*F)
1,CPBAR(*F),VMW(*F),PHIK(*F,*B),DRHOH,DRHOK(*B),ZK(*B),DZKH(*B),  D
2MU3K(*B),DMU4K(*B),DTK(*B),DPHIKH(*B),DPRK(*B),DSCK(*B),DCAPCK(*B)
3,DHTILK(*B),DQRK(*B),DCPBK(*B),DCPTK(*B),DMU12K(*B),DZKK(*B,*B)
4,DPHIKK(*B,*B),      DMU4H,DMU3H,DHTILH,VMU12,CT,CTR,CPTIL,HTIL
5,VMU3,DTH,DCAPCH,DPRH,DSCH,DQRH,DCPBH,DCPTH,DMU12H,VMU(*F),  RHOP
6(*F),PHIKP(*F),HP,TP,ZKP(*B),VMU3P,VMU4P,HTILP,CRHO(*D),GMR(*F)
 COMMON /BLQCOM/FAMOA(**M),FAMOB(**M),N    ,FR(**M,*F),W(3),LEF(*E)
1,LEFS(*E),PIEASE,LEFW(*E)
 COMMON /EQPCOM/ RB(**M,2),RC(**M,2),RD(**M,2),RE(**M,2),RF(**M,2),
1 TU(**M,2),FF(**M),FFA,IFC(**M),ATA(*E),ATB(*E),ATC(*E),WAT(*E),
2 KAT(*E),IR(*E),IS,KR(10),LAMI(**M),P,T,TK(*E,*A),VN(**M),
3 VNU(**M,*E),ITFF,KR2,HCH,NCV,WM,WTM(**M),Y(**M),YW(**M),GG(**M)
4 ,TQ(*E,*A),EPOVRK,SIGMA,BASMOL
 COMMON /EQTCOM/SIP,HIP,EL,ENL,FLIQ,CPF,IRE,IER,AA,ITS,IN,IL,IT,
1 MODE,HMELT,SMELT,TMAX,TMIN,MELT,SUMN,SUML,WS,WSS,B1,ISP2,ISPQ,
2 ISP,KKJ,SVA,SVB,SVC,SVD,SUMC,FFF,CMF,EP,RV,IFCJC,WTG,WTL,JC,HG,
3 CPG,TTMIN,TTMAX,L2,L3,IB(*G),EB(*E),EBL(*E),A(*I,*I),B(*I),
4 IP(**M),ALP(*E),FNU(*E),GAMH(*E),GAMF(*E),SLAM(*E),DY(**M),RVS,
5 CP(**M),H(**M),SB(**M),TC(**M),VLNK(**M),E(**M),PNUS(*E),
6 BC(*E),BLNK(*E),BY(*E),IBC(*E),BE(*E),JJ(*O)
```

LISTING NUMBER 3

```
C00A        7
/BLQCOM/
/FLXCOM/
/HISCOM/
/INTCOM/
/PRMCOM/
/PRPCOM/
/VARCOM/
/WALCOM/

B01A
/BLQCOM/
/BUMCOM/
/COECOM/
/COECON/
/CRBCOM/
/EDGCOM/
/EPSCOM/
/EQPCOM/
/EQTCOM/
/ERRCOM/
/ETACOM/
/FLPCOM/
/FLXCOM/
/HISCOM/
/INTCOM/
/KINCOM/
/NONCOM/
/OUTCOM/
/PRMCOM/
/PRPCOM/
/STTCOM/
/TEMCOM/
/VARCOM/
/WALCOM/

B02A
/INTCOM/
/WALCOM/

C02A        4
/BLQCOM/
/EDGCOM/
/FLPCOM/
/HISCOM/
/INTCOM/
/PRMCOM/
/VARCOM/
/WALCOM/

B03A        4
/BLQCOM/
/EDGCOM/
/FLPCOM/
/HISCOM/
/INTCOM/
/PRMCOM/
/VARCOM/
/WALCOM/

B04A
/BLQCOM/
/BUMCOM/
/ERRCOM/
/INTCOM/
/PRMCOM/
/VARCOM/

B05B        7
/BLQCOM/
/BUMCOM/
/COECOM/
/COECON/
/CRBCOM/
/EDGCOM/
/EPSCOM/
/EQPCOM/
/EQTCOM/
/ERRCOM/
/ETACOM/
/FLXCOM/
/HISCOM/
/INTCOM/
/NONCOM/
/PRPCOM/
/VARCOM/
/WALCOM/

B05C        5
/BLQCOM/
/BUMCOM/
/CRBCOM/
/EDGCOM/
/EPSCOM/
/EQPCOM/
/EQTCOM/
/ERRCOM/
/ETACOM/
/FLXCOM/
/HISCOM/
/INTCOM/
/NONCOM/

/PRMCOM/
/PRPCOM/
/TEMCOM/
/VARCOM/
/WALCOM/

B06A
/EDGCOM/
/ERRCOM/
/ETACOM/
/INTCOM/
/PRMCOM/
/VARCOM/

B07A
/EDGCOM/
/HISCOM/
/INTCOM/
/PRMCOM/
/TEMCOM/
/VARCOM/
/WALCOM/

B08B
/COECOM/
/COECON/
/EDGCOM/
/ETACOM/
/HISCOM/
/INTCOM/
/PRPCOM/
/VARCOM/

B09A
/CRBCOM/
/ETACOM/
/INTCOM/
/PRMCOM/

B10A
/ETACOM/
/HISCOM/
/INTCOM/
/PRMCOM/
/VARCOM/

B11A        4
/BLQCOM/
/COECOM/
/COECON/
/CRBCOM/
/EDGCOM/
/EPSCOM/

/EQPCOM/
/EQTCOM/
/ETACOM/
/FLXCOM/
/HISCOM/
/INTCOM/
/OUTCOM/
/PRMCOM/
/PRPCOM/
/TEMCOM/
/VARCOM/
/WALCOM/

B11B        7
/BLQCOM/
/COECOM
/COECON/
/CRBCOM/
/EDGCOM/
/EPSCOM/
/EQPCOM/
/EQTCOM/
/ETACOM/
/FLXCOM/
/HISCOM/
/INTCOM/
/OUTCOM/
/PRMCOM/
/PRPCOM/
/TEMCOM/
/VARCOM/
/WALCOM/

B12B        3
/COECOM/
/COECON/
/ERRCOM/
/ETACOM/
/HISCOM/
/INTCOM/
/NONCOM/
/PRPCOM/
/VARCOM/

B13B        4
/COECOM/
/COECON/
/ERRCOM/
/ETACOM/
/HISCOM/
/INTCOM/
/NONCOM/
/PRPCOM/
```

LISTING NUMBER 3 (continued

```
B14A
/EDGCOM/
/INTCOM/
/PRMCOM/
/PRPCOM/
/STTCOM/

B14B
/STTCOM/

B19A        4
/COECOM/
/COECON/
/EDGCOM/
/EPSCOM/
/ERRCOM/
/ETACOM/
/HISCOM/
/INTCOM/
/NONCOM/
/PRPCOM/
/VARCOM/

B19T        4
/COECOM/
/COECON/
/EDGCOM/
/ETACOM/
/HISCOM/
/INTCOM/
/NONCOM/
/PRMCOM/
/PRPCOM/
/TEMCOM/
/VARCOM/

B20A       11
/BLQCOM
/BUMCOM/
/EDGCOM/
/EQPCOM
/EQTCOM
/FLPCOM/
/FLXCOM/
/INTCOM
/NONCOM/
/PRPCOM
/VARCOM/
/WALCOM/

B21A        5
/BLQCOM
/EQPCOM
/EQTCOM

B22A       10
/BLQCOM
/BUMCOM/
/EQPCOM
/EQTCOM
/KINCOM/
/NONCOM/

B23A        9
/BLQCOM
/EQPCOM
/EQTCOM

B24A       13
/BLQCOM
/EQPCOM
/EQTCOM
/KINCOM/

B25A        5
/BLQCOM
/EDGCOM/
/EQPCOM
/EQTCOM
/INTCOM
/PRPCOM
/WALCOM/

B27A
/ETACOM/
/INTCOM/

B28A        5
/EQPCOM
/EQTCOM
/KINCOM/

B29A
/BLQCOM/
/ETACOM/
/INTCOM/
/PRMCOM/
/VARCOM/

B30C
/ERRCOM/
/ETACOM/
/NONCOM/
```

LISTING NUMBER 4

```
      DIMENSION HIST1(**Q),HIST2(**R),HIST3(**S),VMAT(**T),HIST4(**U)   C02A 003
      DO 141 I=1,**T                                                     C02A 035
      DIMENSION HIST1(**Q),HIST2(**R),HIST3(**S),VMAT(**T),HIST4(**U)   B03A 003
      DO 184 I=1,**T                                                     B03A 091
      DIMENSIONDQJRNL(**M,1)                                             B05B 004
      DIMENSIONDELQJW(1) ,DQJNL(**N,1) ,WALLQJ(1)                        B05B 005
      DIMENSIONCOEEQV(84),COEFQV(**X)                                    B05B 006
      CALL RERAY(NAM,AM,NSP + 1,ENL,1,LAR,IX,**N)                        B05A2290
  725 DO 730 I=1,**P                                                     B05A4790
      DO 735 I=1,**N                                                     B05A4810
      DIMENSIONDQJRNL(**M,1)                                             B05C 003
      DIMENSIONDELQJW(1) ,DQJNL(**N,1) ,WALLQJ(1)                        B05C 004
      CALL RERAY(NRNL-II,AM(II+1,II+4),0,DRNL(II+1),1,0,IXX,**N)         B05C3800
      DIMENSION CIJ(**M,1)                                               B11A 003
      DIMENSION HIW(**M,3),VKIE(**M),VKIW(**M),ZIE(**M),ZIW(**M),        B11B 003
     1ZIESTR(**M),ZIWSTR(**M),ZKWSRT(*C),ZKESRT(*C),ZKWSTT(*C),ZKESTT(*CB11B 004
     2),ZISDIF(**M),ZKDIF(*C),ZKTDIF(*C),CMK(*C)                         B11B 005
      DIMENSION CIJ(**M,1)                                               B11B 006
      DIMENSION CK23(*B),CK24(*B),CK25(*B),CK26(*B)                      B13B 003
      DIMENSION D(ND,1),SD(**N),C(ND,1),L(**N),S(**N),LL(**N),LLL(**N),  B15B 003
     1LS(1)                                                              B15B 004
      COMMON/ETACOM/ETA(*F),DETA(*F)                                     B18A 004
      DIMENSION X(1),A(*D),B(*D),C(*D)                                   B18A 005
      DIMENSION EPSOUT(**A)                                              B19A 003
      DIMENSION DRHS(**N)                                                B19T 003
      EQUIVALENCE(TU(**V),TF),(VNU,CIJ)                                  B20A 006
      DIMENSION CIJ(**M,1),TF(1)                                         B20A 007
      DIMENSION APE(*I,*I),BS(*I)                                        B20A 008
      DIMENSION VLAM(**M,1),  X(*I),GAMK(**M,1),KQ(10),DQJRNL(**M,1)     B20A 009
      EQUIVALENCE(AM(**W),DQJRNL(**W),GAMK,VLAM)                         B20A 010
      CALL RERAY(IN,A,0,B,0,0,IG,*I)                                     B20A 263
      CALL RERAY(IN,APE(IL,IL),0,B(IL),1,0,IG,*I)                        B20A 373
      DIMENSION CIJ(**M,1),TF(1)                                         B21A 003
      EQUIVALENCE(TU(**V),TF),(VNU,CIJ)                                  B21A 004
      DIMENSION VLAM(**M,1),  X(*I)                                      B22A 005
      EQUIVALENCE(AM(**W),VLAM)                                          B22A 006
      DIMENSION CIJ(**M,1),TF(1)                                         B22A 007
      DIMENSION ECD(**M)                                                 B22A 008
      EQUIVALENCE(TU(**V),TF),(VNU,CIJ)                                  B22A 009
      DIMENSION CIJ(**M,1),TF(1)                                         B23A 005
      EQUIVALENCE(TU(**V),TF),(VNU,CIJ)                                  B23A 006
      DIMENSION X(*I)                                                    B23A 007
      DIMENSION CMFF(**M)                                                B23A 008
      DIMENSION CIJ(**M,1),TF(1)                                         B24A 006
      DIMENSION UM(*E,*E)                                                B24A 007
      EQUIVALENCE(TU(**V),TF),(VNU,CIJ)                                  B24A 008
      DIMENSION C(*E),KPHA(2),RA(2), IM(*E),JAT(8),ALPT(8),TAU(*E,*E)    B24A 009
      DIMENSION IC( *E),LIM(*E,*E)                                       B24A 010
      DIMENSION FFIN(**M),NFIA(**M),NFIB(**M)                            B24A 011
```

LISTING NUMBER 4 (continued)

```
      DIMENSION IFMET(**M),IGMET(**M),ZIGEPS(2),SORCE(8)                B24A 012
      DIMENSION VK(*E),PA(*N,*N),PV(*G,*N)                              B25A 005
      DIMENSION ELKM(*M),DELK(*M)                                       B28A 004
```

SECTION IX

FORTRAN VARIABLES LIST

The Fortran variables are listed and defined at the end of this section. The routines within which the variables are valid are identified as follows. An L followed by a name in the right-hand column indicates that the variable is local to the routine of that name (e.g., L EQUIL). A C followed by a blank indicates the variable appears in unlabelled common, a C followed by a name indicates the variable appears in a labelled common of that name (e.g., C EQTCOM), and an E followed by a name indicates the variable is equivalenced to a variable appearing in a labelled common of that name (e.g., E EQTCOM). A tabulation of the common blocks included in the various subroutines was presented in the previous section.

An asterisk (*) appearing before the equal sign (=) in the Fortran variables definition list indicates that the variable is valid only in the chemistry routines (EQUIL, PROPS, THERM, MATER, KINET, CRECT, INPUT) whereas a plus sign (+) indicates the variable is not valid in the chemistry routines. If neither a * or a + is indicated, the variable is valid in any routine which contains the variable in the appropriate COMMON block.

In the Fortran variables list, the subscripts have the following convention:

I = I^{th} nodal point or nodal segment

J = J^{th} species (molecular, atomic, ionic and condensed)

K,KK = K^{th} or KK^{th} element, base species, or related quantity

L = L^{th} streamwise station

M = M^{th} time (or subcase)

MK = MK^{th} kinetically controlled reaction

N,NN = Other meanings, defined as used

Finally, variables referred to in the definitions are Fortran variable names except where specifically identified otherwise (e.g., in the definition of AM(N,NN), (BNL) is not a Fortran variable name but is defined in a referenced report).

A(N,NN)	ERROR COEFFICIENT ARRAY IN CHEMISTRY SOLUTION, N PERTAINS TO EQUATION WHEREAS NN PERTAINS TO VARIABLE.	C	EQTCOM
AA	PRODUCT OF PRESSURE TIMES MOLECULAR WEIGHT.	C	EQTCOM
AAA	DEFUNCT VARIABLE, SET TO UNITY.	C	EQPCOM
AB	LOCALLY DEFINED VARIABLE	L	SLOPQ
ABB	LOCALLY DEFINED VARIABLE	L	SLOPQ
ABER	ABSOLUTE VALUE OF RATIO OF A MASS BALANCE ERROR TO LARGEST TERM IN THAT MASS BALANCE.	L	MATER
ABSVA	ABSOLUTE VALUE OF CONTRIBUTION OF A SPCIES TO A MASS BALANCE.	L	MATER
ABX	ABSOLUTE VALUE OF LOG CORRECTION ON TEMPERATURE.	L	CRECT
AC	LOCALLY DEFINED VARIABLE	L	SLOPQ
ACC	LOCALLY DEFINED VARIABLE	L	SLOPQ
ACH	MACH NUMBER	L	OUTPUT
ADUM	COEFFICIENT IN SURFACE KINETIC RELATION FOR MATERIAL BEING CONSIDERED UNDER KR(9) = 5 OR 6 (SEE INPUT INSTRUCTIONS).	C	CRBCOM
AF	LOCALLY DEFINED VARIABLE	L	TRMBL
ALF	DERIVATIVE OF LOG MOLECULAR WEIGHT WITH RESPECT TO LOG TEMPERATURE AT CONSTANT PRESSURE.	L	EQUIL
ALP(K)	INPUT MASS QUANTITY OF ELEMENTS, EQ(25) OF NASA CR-1064.	C	EQTCOM
ALPH	NORMALIZING PARAMETER FOR BOUNDARY LAYER NORMAL COORDINATE, SEE EQ. (33) OF NASA CR-1062.	C	VARCOM
ALPHD	D1*ALPH + D2*HALPH WHERE D1 AND D2 ARE DEFINED BY EQ(88) OR (89) OF NASA CR-1062.	C	HISCOM
ALPT(N)	NUMBER OF ATOMS OF AN ELEMENT WITH ATOMIC NUMBER JAT(N) IN A SPECIES.	L	INPUT
ALSQ	ALPH**2	L	FIRSTG
AM(N,NN)	COEFFICIENTS IN THE MATRIX DEFINED AS (BNL) IN EQ(150) OF NASA CR-1062.	C	NONCOM
AMOA	ALPHANUMERIC VARIABLE, FIRST OF TWO PORTIONS OF SPECIES NAME.	L	INPUT

AMOB	ALPHANUMERIC VARIABLE, SECOND OF TWO PORTIONS OF SPECIES NAME.	L	INPUT
AMU5	VN(J) * WTM(J)/(FF(J) * (WDZ-VN(J) * FF(J) * WD7)) SUMMED OVER ALL SPECIES N *.	L	PROPS
APE(N,NN)	SAVED ARRAY A(N,NN) DURING INVERSION.	L	EQUIL
AR	WEIGHTING FACTOR IN LINEARIZING EQUILIBRIUM ASPECT OF KINETICALLY CONTROLLED MASS BALANCE.	L	KINET
AREA	AREA PER UNIT MASS FLOW DURING EXPANSION.	L	EQUIL
ARPH	ELEMENTAL MASS FRACTION OF ATOM.	L	EQUIL
ARPHM	MAXIMUM CONTRIBUTION TO CALCULATION OF AN ARPH.	L	EQUIL
ASTAR	A* USED IN TRANSPORT PROPERTIES	L	PROPS
ASU	FIRST FOUR CHARACTERS OF ALPHAMERIC NAME OF ASSIGNED SURFACE SPECIES	C	CRBCOM
ATA(K)	ALPHANUMERIC VARIABLE, FIRST OF THREE PORTIONS OF ELEMENT NAME.	C	EQPCOM
ATB(K)	ALPHANUMERIC VARIABLE, SECOND OF THREE PORTIONS OF ELEMENT NAME.	C	EQPCOM
ATC(K)	ALPHANUMERIC VARIABLE, THIRD OF THREE PORTIONS OF ELEMENT NAME.	C	EQPCOM
ATEMP	ABS(DTEMP)	L	NONCER
B(N)	ERRORS USED WITH COEFFICIENTS TO YIELD CORRECTIONS IN CHEMISTRY ITERATIONS, IDENTICAL TO BB*.	C	EQTCOM
B(N)	ARRAY OF CONSTANTS DEFINED IN BLIMP, IDENTICAL TO BB*.	C	INTCOM
B1	SAVED VALUE OF B(1) DURING INVERSION. EQUALS SURFACE EQUILIBRIUM ERROR FOR THAT OPTION.	L	EQUIL
B1(I)	DSQ(I-1)/6	C	ETACOM
B2(I)	DSQ(I-1)/3	C	ETACOM
BA1(N,NN)	MATRIX (BLFF) DEFINED BY FIGURE (3) OF NASA CR-1062 PREMULTIPLIED BY INVERSE OF (ALFF).	C	ETACOM
BA2(N,NN)	MATRIX (BLHH) OR (BLKK) DEFINED BY FIGURE (3) OF NASA CR-1062 PREMULTIPLIED BY INVERSE OF (ALHH) OR (ALKK), RESPECTIVELY.	C	ETACOM
BASMOL	MOLECULAR WEIGHT OF REFERENCE SPECIES IN DIFFUSION FACTOR CALCULATIONS	C	EQTCOM
BDUM	COEFFICIENT IN SURFACE KINETIC RELATION FOR MATERIAL BEING CONSIDERED UNDER KR(9) = 5 OR 6 (SEE INPUT INSTRUCTIONS).	C	CRBCOM

BETA	BETAM(L)	C	HISCOM
BETAM(L)	STREAMWISE PRESSURE GRADIENT PARAMETER DEFINED BY EQ(53) OF NASA CR-1062.	C	HISCOM
BETH	DERIVATIVE OF LOG MOLECULAR WEIGHT WITH RESPECT TO LOG PRESSURE AT CONSTANT TEMPERATURE.	L	EQUIL
BF	LOCALLY DEFINED VARIABLE	L	TRMBL
BIP	NOMINALLY ZERO, SET TO 1. TO PREVENT PREMATURE CONVERGENCE	L	NONCER
BLOW	BLOWING PARAMETER BASED ON GAS MASS FLUX GIVEN BY RHOVW(IS,1)/(C3 * CH).	C	OUTCOM
BLOWCH	CHAR FLUX NORMALIZED BY HEAT TRANSFER COEFFICIENT	L	OUTPUT
BLOWPG	PYROLYSIS GAS FLUX NORMALIZED BY HEAT TRANSFER COEFFICIENT	L	OUTPUT
BLQEQV	VARIABLE EQUIVALENCED TO BLQCOM FOR DUMPING PURPOSES	L	DUMCOM
BS(N)	SAVED ARRAY OF B(N) DURING INVERSION.	L	EQUIL
BSU	SECOND FOUR CHARACTERS OF ALPHAMERIC VALUE OF ASSIGNED SURFACE SPECIES	C	CRBCOM
BULP	LOG (BUMP).	L	CRECT
BUMEQV	VARIABLE EQUIVALENCED TO BUMCOM FOR DUMPING PURPOSES	L	DUMCOM
BUMP	CONTRIBUTION TO DAMPING FACTOR EASE RESULTING FROM SIGN CHANGES IN CRITICAL ERRORS.	C	BUMCOM
BUMP	10**4 * P, CONSTRAINTS ON CORRECTIONS ARE RELAXED FOR PARTIAL PRESSURES BELOW THIS VALUE.	L	CRECT
C(K)	GRAM ATOMS OF ELEMENT K IN A MOLECULE.	L	INPUT
C1	1 +DZ WHERE DZ IS DEFINED BY EQ(88) OR (89) OF NASA CR-1062	C	HISCOM
C2	-(1+2*DZ) WHERE DZ IS DEFINED BY EQ(88) OR (89) OF NASA CR-1062.	C	HISCOM
C3	C3M(L)	C	HISCOM
C3M(L)	-1/ALPHASTAR WHERE ALPHASTAR IS THE FLUX NORMALIZING PARAMETER DEFINED BY EQ (44) OF NASA CR-1062.	C	HISCOM
C4	BETA+1+DZ WHERE DZ IS DEFINED BY EQ(88) OR (89) OF NASA CR-1062.	C	HISCOM
C5	1./ALPH	C	COECOM
C6	BETA * ALPH**2	C	COECOM

C7	-(UE(L)**2)/((ALPH**2)*25036.5)	C COECOM
C8	ALPHD/ALPH	C COECOM
C9	BETA+1.+DZ - ALPHD/ALPH	C COECOM
C10	C7*F(2,I)	C COECOM
C11	F(3,I)/ALPH	C COECOM
C12	CAPC(I)/ALPH	C COECOM
C13	C7 * F(3,I)	C COECOM
C14	(1.+DZ)*F(1,I)+HF(I,5)	C COECOM
C15	PR(I)-1	C COECOM
C16	1./PR(I)	C COECOM
C17	1./SC(I)	C COECOM
C18	CTR*T(I)	C COECOM
C19	CAPC(I)/(ALPH*SC(I))	C COECOM
C20	CAPC(I)/(ALPH*PR(I))	C COECOM
C21	1./CAPC(I)	C COECOM
C22	C7*F(3,I)*(PR(I)-1.)*CAPC(I)/(ALPH*PR(I))	C COECOM
C23	C3M(L)*QR(I)	C COECOM
C24	CTR*VMU3	C COECOM
C25	1./VMU12	C COECOM
C26	RHOE(L)/RHO(I)	C COECOM
C27	-VMU4P*CAPC(I)/(ALPH*SC(I))	C COECOM
C28	CPBAR(I)*TP	C COECOM
C29	CTR/VMU12	C COECOM
C30	CT*CTR/VMU12	C COECOM
C31	HTILP-(CPTIL+C30)*TP+CTR*T(I)*VMU3P+(HTIL-H(I)+CTR*VMU3 * T(I)) * VMU4P	C COECOM
C32	-(F(2,I)*C7*F(3,I)*CAPC(I)/ALPH+C3M(L)*QR(I))+CPBAR(I)* TP * CAPC(I)/(ALPH*PR(I))+C31*CAPC(I)/(ALPH*SC(I))	C COECOM
C33	(C32+C3M(L)*QR(I))/CAPC(I)	C COECOM

C34	CAPC(I)/(ALPH*(PR(I)**2))	C COECOM
C35	-CPBAR(I)*TP*CAPC(I)/(ALPH*(PR(I)**2))	C COECOM
C36	-C31*CAPC(I)/ALPH*(SC(I)**2))	C COECOM
C37	TP*CAPC(I)/ALPH	C COECOM
C38	TP*CAPC(I)/(ALPH*PR(I))	C COECOM
C39	=-TP*CAPC(I)/(ALPH*SC(I))	C COECOM
C40	TP*CAPC(I)*CT*CTR/(VMU12**2*ALPH*SC(I))	C COECOM
C41	(VMU4P*VMU3+VMU3P)*CTR*CAPC(I)/(ALPH*SC(I))	C COECOM
C42	VMU4P*CAPC(I)*CTR*T(I)/(ALPH*SC(I))	C COECOM
C43	C27+DCAPCH*C33+DPRH*C35+DSCH*C36-DQRH*C3M(IS)+DCPBH*C38 + DCPTH*C39+DMU12H*C40-DHTILH*C27+DTH*C41+DMU3H*C42	C COECOM
C44	(CAPC(I)/ALPH)*(1./SC(I)-1./PR(I))	C COECOM
C45	(CAPC(I)/ALPH)*(CPBAR(I)/PR(I)-(CT*CTR/VMU12+CPTIL)/SC(I))	C COECOM
C46	CTR*T(I)*CAPC(I)/(ALPH*SC(I))	C COECOM
C47	(CAPC(I)/ALPH*SC(I))) * (HTIL-H(I)+VMU3 * CTR * T(I))	C COECOM
C48	(CAPC(I)/ALPH)*(1./SC(I)-1./PR(I)) + DTH*C45+DMU3H*C46 + DMU4H*C47	C COECOM
C49	RHOE(L)/(RHO(I)**2)	C COECOM
C50	BETA*(ALPH**2)*RHOE(L)/(RHO(I)**2)	C COECOM
C51	DRHOH*C50	C COECOM
C52	C7 * F(2,I) * C51	C COECOM
C53	RHOP(I)/RHO(I)	C COECOM
C54	BETA*(ALPH**2)*RHOE(L)*RHOP(I)/(RHO(I)**3)	C COECOM
C55	-DRHOH * C54	C COECOM
C56	F(2,I)/ALPH	C COECOM
C57	C7 * F(3,I) *BETA*ALPH**2*RHOE(L)/(RHO(I)**2)	C COECOM
C58	-C7 * F(2,I)*DRHOH * C54	C COECOM
C59	-F(2,I)*(CRHOH*C57 + C58)/ALPH	C COECOM

C60	C7 * F(2,I) * C43	C COECOM
C61	C7 * F(3,I) * C48	C COECOM
C62	-BETA * ALPH**2 * RHOE(L) * DSQ(I-1)/(12.*RHO(I)**2)	C COECOM
C63	BETA*ALPH**2*CRHO(I-1)	C COECOM
C64	BETA*ALPH**2*(RHOE(L)/RHO(I)**2) *DETA(I-1)*(.5-DETA(I-1) *RHOP(I)/(6.*RHO(I)))	C COECOM
C65	NOT CURRENTLY USED.	C COECOM
C66	-DRHOH*C64	C COECOM
C67	-DRHOH*BETA*ALPH**2*RHOE(L)*DSQ(I-1)/(12*RHO(I)**2)	C COECOM
C68	-(F(2,I)/ALPH)*(C67*2*F(3,I)-F(2,I)*DRHOH*C64)*C7	C COECOM
C69	C7*DRHOH*(F(3,I)*C62-F(2,I)*C64)	C COECOM
C70	C7*F(2,I)*C67	C COECOM
C71	NOT CURRENTLY USED.	C COECOM
C72	F(2,I)*XM(1)+F(3,I)*XM(2)+F(4,I)*XM(3)+F(4,I-1)*XM(4) = INTEGRAL OF (F(2,I) * F(2,I) * DETA).	C COECOM
C73	(1.+DZ) * F(2,I)	C COECOM
C74	C7 * DCAPCH * F(3,I) * F(2,I)/ALPH + (1.+DZ) * F(1,I) + HF(I,5)	C COECOM
C75	DCAPCH * F(3,I)/ALPH	C COECOM
C76	(1.+DZ) * G(1,I)	C COECOM
C77	C7 * F(3,I) * (1.-PR(I)) * CAPC(I)/(ALPH * PR(I)) + C7 * (F(2,I) * C43 + F(3,I) * C48)	C COECOM
C78	C7 * F(2,I) * (C48-(PR(I)-1.) * CAPC(I)/(PR(I) * ALPH))	C COECOM
C79	C43 + (1.+DZ) * F(1,I) + HF (I,5)	C COECOM
C80	C48 + CAPC(I)/(ALPH * PR(I))	C COECOM
C81	-(C7 * F(2,I)**2 * DCAPCH + CAPC (I)) * F(3,I)/(ALPH**2)	C COECOM
C82	-(C3M(L) * QR(I) + C32)/ALPH + 2. * F(2,I) *C22/ALPH - F(2,I) * C7 *(F(2,I) * C43 + 2 * F(3,I) * C48)/ALPH	C COECOM
C83	CAPC(I) * F(3,I)/ALPH + ((1+DZ) * F(1,I) + HF(I,5))*F(2,I)	C COECOM
C84	C32 + G(1,I) * ((1 + DZ) * F(1,I) + HF(I,5))	C COECOM

C85	DETA(I-1) * BETA * ALPH**2 * RHOE(IS)/(RHO(I)**2) * (0.5+DETA(I-1) * RHOP(I)/(RHO(I)*6))	C COECOM
C86	DSQ(I-1) * BETA * ALPH**2 * RHOE(L)/(12*RHO(I)**2)	C COECOM
C87	C7 * F(3,I) * C86 * DRHOH	C COECOM
C88	C7 * DRHOH * F(2,I) * C85	C COECOM
C89	BETA * (ALPH ** 2) * CRHO1	L IONLY
C89	-C3 * ALPH * VMUE(L)	L OUTPUT
C90	ALPH * DUEDGE	C EDGCOM
CAPC(I)	PRODUCT OF DENSITY AND VISCOSITY NORMALIZED BY EDGE VALUE.	C PRPCOM
CASE(N)	ALPHANUMERIC NAME OF CASE.	C INTCOM
CBAR	VALUE OF THE VELOCITY RATIO AT BOUNDARY LAYER NODE KAPPA.	C INTCOM
CDUM	COEFFICIENT IN SURFACE KINETIC RELATION FOR MATERIAL BEING CONSIDERED UNDER KR(9) = 5 OR 6 (SEE INPUT INSTRUCTIONS).	C CRBCOM
CF	MOMENTUM TRANSFER COEFFICIENT GIVEN BY CAPC(1)/ALPH * VMUE(IS)/C89*F(3,1)	C OUTCOM
CH	HEAT TRANSFER COEFFICIENT BASED ON ENTHALPY POTENTIAL, GIVEN BY -WALLQ/(C3*(G(1,NETA)-G(1,1)))	C OUTCOM
CHFLUX	LESS THAN ZERO VALUE IMPLIES PRESENCE OF CHAR ELEMENTS IN SURFACE CHEMISTRY	L EQUIL
CH(N)	CURVE FIT CONSTANTS FOR THERMODYNAMIC DATA (THE QUANTITY F2 + H298 DISCUSSED IN GROUP 12 OF INPUT INSTRUCTIONS) N=1 FOR LOW AND 2 FOR HIGH TEMPERATURE RANGE, IDENTICAL TO CCHH+	C EQPCOM
CIJ(K,KK)	GRAM ATOM OF ELEMENT K IN BASE SPECIES KK.	E EQPCOM
CK1(K)	DCAPC(K) * C33 + DPRK(K) * C35 + DSCK(K) * C36-DQRK(K) * C38 + DCPTK(K) * C39 + DMU12K(K) * C40-DHTILK(K) * C27 + DTK(K) * C41 + DMU3K(K) * C42	C COECON
CK2(K)	DTK(K) * C45 + DMU3K(K) * C46 + DMU4K(K) * C47	C COECON
CK3(K)	ZK(K)-SP(1,I,K)	C COECON
CK4(K)	CAPC(I) * (ZK(K)-SP(1,I,K))/(ALPH * SC(I))	C COECON
CK5(K)	DZKH(K) * (CAPC(I)/(ALPH * SC(I))) + DMU4H * CK4(K)	C COECON
CK6(K)	ZKP(K) * (CAPC(I)/(ALPH * SC(I))) + VMU4P * CK4(K)	C COECON
CK9(K)	DZKH(K) * VMU4P * (CAPC(I)/(ALPH * SC(I))) + CK6(K) * DCAPCH/CAPC(I) - CK6(K) * DSCH/SC(I)	C COECON

CK13(K)	-DRHOK(K) * BETA * ALPH**2 * (RHOE(L)/RHO(I)**2) * DETA(I-1) * RHOP(I)/(6*RHO(I))).	C COECOM
CK14(K)	B1(I-1) * DPHIKH(K)	C COECON
CK15(K)	C7 * G1(I-1) * DPHIKH(K) * F(3,I)	C COECON
CK16(K)	PHIKP(K) * B1(I-1)	C COECON
CK17(K)	DCAPCK(K) * F(3,I)/ALPH	C COECON
CK18(K)	SP(1,I,K) * (1+DZ)	C COECON
CK19(K)	C7 * (F(3,I) * CK5(K) + F(2,I) * CK9(K))	C COECON
CK20(K)	C7 * CK5(K) * F(2,I)	C COECON
CK21(K)	-C7 * (F(2,I)/ALPH) * (F(2,I) * CK9(K) + 2 * F(3,I) * CK5(K)) - CK6(K)/ALPH	C COECON
CK22(K)	CK6(K) + SP(1,I,K) * ((1+DZ) * F(1,I) + HF(I,5))	C COECON
CK23(K)	DSQ(I-1) * DPHIKH(K) / 3.	L IONLY
CK24(K)	C7 * F(3,I) * CK23(K)	L IONLY
CK25(K)	DETA(I-1) * DPHIKH(K)	L IONLY
CK26(K)	C7 * F(2,I) * CK25(K)	L IONLY
CKK1(K,KK)	DZKK(K,KK) * CAPC(I)/(ALPH * SC(I)) + CK4(K) * DMU4K(KK), K TH EQUATION, KK TH ELEMENT.	C COECON
CKK2(K,KK)	DZKK(K,KK) * VMU4P * (CAPC(I)/(ALPH * SC(I))) + DCAPCK(KK) * (CK6(K)/CAPC(I))-DSCK(KK) * CK6(K)/SC(I) (PLUS (1.+DZ) * F(1,I) + HF (I,5) - VMU4P * CAPC(I)/(ALPH*SC(I)) FOR K=KK ONLY). K TH EQUATION, KK TH ELEMENT.	C COECON
CKK3(K,KK)	DPHIKK(K,KK)	C COECON
CL	L(I) IN MIXING LENGTH FORMULATION. SEE REF. 1.	C EPSCOM
CLNUM	CLAUSER NUMBER USED IN DEFINING EDDY VISCOSITY IN THE WAKE PORTION OF THE BOUNDARY LAYER.	C EPSCOM
CM(K)	ELEMENTAL MASS TRANSFER COEFFICIENTS BASED ON MASS FRACTION POTENTIAL, GIVEN BY VJKW(K)/(DUM(K)*WAT(K)) WHERE DUM(K) IS THE SUMMATION OVER KK OF (SP(1,NETA,KK) -SP(1,1,KK))/ WTM(KK)*CIJ(K,KK)	L OUTPUT
CMF	THE FACTOR BY WHICH ALL CORRECTIONS ARE DAMPED DURING CHEM- ISTRY ITERATIONS.	L CRECT

CMFF(J)	THE VALUE OF CMF AFTER CONSIDERATION OF CONSTRAINTS ON THE CORRECTION TO BE APPLIED TO THE PARTIAL PRESSURE OF THE JTH SPECIES.	L CRECT
COEEQV(N)	GLOBAL SET OF COEFFICIENTS C5,C6,C7, ETC.	E COECOM
COEFQV(N)	GLOBAL SET OF COEFFICIENTS CK1,CK2, ETC.	E COECON
COND	THERMAL CONDUCTIVITY	L OUTPUT
CONE	CONE HALF-ANGLE FOR SPHERE-CONE SHAPED BODIES.	C PRMCOM
CONEQV	VARIABLE EQUIVALENCED TO COECON FOR DUMPING PURPOSES	L DUMCOM
CORAR(N)	CORRECTION ARRAY, COMPOSED OF CORRECTIONS IN H(I), I = 1 TO NETA, AND (SP(1,I,K), I= 1, NETA), K= 1, NSPM1.	E NONCOM
CORMA	THE VALUE OF THE MAXIMUM CORAR.	C BUMCOM
CP(J)	SPECIFIC HEAT.	C EQTCOM
CPA	LOCALLY DEFINED VARIABLE	L MATER
CPBAR(I)	FROZEN SPECIFIC HEAT OF THE MIXTURE.	C PRPCOM
CPF	FROZEN SPECIFIC HEAT, IDENTICAL TO CCPF+.	C EQTCOM
CPG	FROZEN SPECIFIC HEAT OF GAS, IDENTICAL TO CCPG+.	C EQTCOM
CPT	FROZEN SPECIFIC HEAT OF GAS.	L STATE
CPTIL	PROPERTY OF THE GAS MIXTURE WHICH REDUCES TO CPBAR FOR EQUAL DIFFUSION COEFFICIENTS, SEE EQ(28) OF NASA CR-1062.	C PRPCOM
CRBEQV	VARIABLE EQUIVALENCED TO CRBCOM FOR DUMPING PURPOSES	L DUMCOM
CRHO(I-1)	C26 * DETA(I-1) * (1.-(RHOP(I)/RHO(I)) * DETA(I-1)/6)	C PRPCOM
CRHO1	(RHOE(L) / RHO(I)) * DETA(I-1) * (1.+DETA(I-1) * RHOP(I) / (RHO(I) * 6.))	L IONLY
CSP	EQUILIBRIUM SPECIFIC HEAT OF GAS.	L EQUIL
CT	COEFFICIENT APPEARING IN THE APPROXIMATION FOR THERMAL DIF-FUSION COEFFICIENTS, SEE EQ(26) OF NASA CR-1062, NUMERICAL-LY EQUAL TO -0.5, SET EQUAL TO ZERO WHEN THERMAL DIFFUSION NEGLECTED.	C PRPCOM
CTR	CT * UNIVERSAL GAS CONSTANT.	C PRPCOM
CXM	LOCALLY DEFINED VARIABLE	L IONLY
CYM	LOCALLY DEFINED VARIABLE	L IONLY

CYSP	LOCALLY DEFINED VARIABLE	L IONLY
D	RERAY-SET OF CONSTANT VECTORS CONVERTED TO SOLUTION VECTORS	L RERAY
D	TAYLOR-ARGUMENT REPRESENTING DELTA ETA.	L TAYLOR
D1	THE D SUB ONE OF EQ(89) IN NASA CR-1062.	L HISTXI
D2	THE D SUB TWO OF EQ(89) IN NASA CR-1062.	L HISTXI
D2UEDG	SECOND DERIVATIVE OF UEDGE WITH RESPECT TO STREAM FUNCTION, SEE EQ(68) OF NASA CR-1062 (SET EQUAL TO ZERO IN PRESENT PROGRAM).	C EDGCOM
DBAR	REFERENCE DIFFUSION COEFFICIENT INTRODUCED IN APPROXIMATION FOR UNEQUAL DIFFUSION COEFFICIENTS, NUMERICALLY EQUAL TO 4.16E-8 * T * SQRT(T) / (OMEGA * P).	L PROPS
DCAPCH	DERIVATIVE OF CAPC WITH RESPECT TO H.	C PRPCOM
DCAPCK(K)	DERIVATIVE OF CAPC WITH RESPECT TO MASS FRACTION OF ELEMENT K.	C PRPCOM
DCLL	DERIVITIVE OF CL AT I WITH RESPECT TO CL AT I-1	L TRMBL
DCLPI	DERIVITIVE OF CL AT I WITH RESPECT TO PI AT I	L TRMBL
DCLPM	DERIVITIVE OF CL AT I WITH RESPECT TO PIM AT I-1	L TRMBL
DCPBH	DERIVATIVE OF CPBAR WITH RESPECT TO H, SET EQUAL TO ZERO IN CURRENT PROGRAM.	C PRPCOM
DCPBK(K)	DERIVATIVE OF CPBAR WITH RESPECT TO MASS FRACTION OF ELE- MENT K, SET EQUAL TO ZERO IN CURRENT PROGRAM.	C PRPCOM
DCPTH	DERIVATIVE OF CPTIL WITH RESPECT TO H, SET EQUAL TO ZERO IN CURRENT PROGRAM.	C PRPCOM
DCPTK(K)	DERIVATIVE OF CPTIL WITH RESPECT TO MASS FRACTION OF ELE- MENT K, SET EQUAL TO ZERO IN CURRENT PROGRAM.	C PRPCOM
DCU(I)	(DETA(I))**3	C ETACOM
DELJW(K)	ERROR IN DIFFUSIVE MASS FLUX, WALLJ(K), INTRODUCED DURING NEWTON-RAPHSON ITERATION.	C FLXCOM
DELQJW(N)	GLOBAL SET DELQW AND DELJW(K).	E FLXCOM
DELQW	ERROR IN DIFFUSIVE HEAT FLUX, WALLQ, INTRODUCED DURING NEW- TON-RAPHSON ITERATION.	C FLXCOM
DELST	DISPLACEMENT THICKNESS GIVEN BY Y(NETA)-C89*(F(1,NETA) -F(1,1))/ALPH.	C OUTCOM
DEPC	CONSTANT IN CORRECTION COEFFICIENTS ON EPSA(I) RESULTING FROM LINEAR CORRECTION COEFFICIENTS	C EPSCOM
DEPS(I)	DERIVATIVE OF EPSA(WITH RESPECT TO NONLINEAR VARIABLES	C EPSCOM

DER(L)	DIMENSIONED VARIABLE USED IN VARIOUS SUBROUTINES BUT NOT USED FOR TRANSMITTING INFORMATION BETWEEN SUBROUTINES.	C TEMCOM
DETA(I)	ETA(I+1) - ETA(I)	C ETACOM
DHTILH	DERIVATIVE OF HTIL WITH RESPECT TO H.	C PRPCOM
DHTILK(K)	DERIVATIVE OF HTIL WITH RESPECT TO MASS FRACTION OF ELEMENT K.	C PRPCOM
DIV	ROW NORMALIZING FACTOR IN GAUSSIAN ELIMINATION.	L RERAY
DIVC	PRODUCT OF 'DIV' AND ELEMENT OF ROW.	L RERAY
DKPT(MK)	DERIVATIVE OF LOG KP WITH RESPECT TO LOG TEMPERATURE.	C KINCOM
DLI(I)	DERIVATIVE OF EL(I) WITH RESPECT TO NONLINEAR VARIABLES	C EPSCOM
DLPH	A(3,1) EVALUATED AT THE WALL.	C NONCOM
DLPK(K)	A(3,K+2) EVALUATED AT THE WALL.	C NONCOM
DLX1	ALOG(XI(L) / XI(L-1))	L HISTXI
DLX2	STORED (HISTORIC) VALUE FOR DLOGXI DEFINED BY EQ(90) OF NASA CR-1062.	C HISCOM
DMU12H	DERIVATIVE OF VMU12 WITH RESPECT TO H, SET EQUAL TO ZERO IN CURRENT PROGRAM.	C PRPCOM
DMU12K(K)	DERIVATIVE OF VMU12 WITH RESPECT TO MASS FRACTION OF ELEMENT K, SET EQUAL TO ZERO IN PRESENT PROGRAM.	C PRPCOM
DMU3H	DERIVATIVE OF VMU3 WITH RESPECT TO H.	C PRPCOM
DMU3K(K)	DERIVATIVE OF VMU3 WITH RESPECT TO MASS FRACTION OF ELEMENT K.	C PRPCOM
DMU4H	DERIVATIVE WITH RESPECT TO H OF THE COEFFICIENT MU4 DEFINED IN EQ(28) OF NASA CR-1062.	C PRPCOM
DMU4K(K)	DERIVATIVE WITH RESPECT TO MASS FRACTION OF ELEMENT K OF THE COEFFICIENT MU4 DEFINED IN EQ(28) OF NASA CR-1062.	C PRPCOM
DPHIKH(K)	DERIVATIVE OF PHIK WITH RESPECT TO H, SET EQUAL TO ZERO IN CURRENT PROGRAM.	C PRPCOM
DPHIKK (K,KK)	DERIVATIVE OF K TH PHIK WITH RESPECT TO MASS FRACTION OF ELEMENT KK, SET EQUAL TO ZERO IN CURRENT PROGRAM.	C PRPCOM
DPI(3+K,2)	(ARRAY OF DERIVATIVES OF PI WITH RESPECT TO PRIMARY VARIABLES)/TREF	C EPSCOM

DPRH	DERIVATIVE OF PR WITH RESPECT TO H, SET EQUAL TO ZERO IN CURRENT PROGRAM.	C PRPCOM
DPRK(K)	DERIVATIVE OF PR WITH RESPECT TO MASS FRACTION OF ELEMENT K SET EQUAL TO ZERO IN CURRENT PROGRAM.	C PRPCOM
DQJNL(N)	GLOBAL SET OF DQNL AND DJNL(K).	E FLXCOM
DQJRNL(N)	DERIVATIVE OF DIFFUSIVE HEAT AND MASS FLUXES, WALLQJ WITH RESPECT TO NTH REDUCED NONLINEAR VARIABLE.	E NONCOM
DQNL(N)	DERIVATIVE OF DIFFUSIVE HEAT FLUX, WALLQ, WITH RESPECT TO N TH NONLINEAR VARIABLE.	C FLXCOM
DQRH	DERIVATIVE OF QR WITH RESPECT TO H, SET EQUAL TO ZERO IN CURRENT PROGRAM.	C PRPCOM
DQRK(K)	DERIVATIVE OF QR WITH RESPECT TO MASS FRACTION OF ELEMENT K SET EQUAL TO ZERO IN CURRENT PROGRAM.	C PRPCOM
DRHOH	DERIVATIVE OF RHO WITH RESPECT TO H.	C PRPCOM
DRHOI	DERIVITIVE OF VELOCITY DEFECT THICKNESS WITH RESPECT TO RHO AT I	L TRMBL
DRHOK(K)	DERIVATIVE OF RHO WITH RESPECT TO MASS FRACTION OF ELEMENT K.	C PRPCOM
DRNL(N)	REDUCED NONLINEAR ERRORS BEFORE MATRIX INVERSION, CORRECTIONS OF VARIABLES IN REDUCED NONLINEAR SET AFTER MATRIX INVERSION.	C ERRCOM
DSCH	DERIVATIVE OF SC WITH RESPECT TO H, SET EQUAL TO ZERO IN CURRENT PROGRAM.	C PRPCOM
DSCK(K)	DERIVATIVE OF SC WITH RESPECT TO MASS FRACTION OF ELEMENT K SET EQUAL TO ZERO IN CURRENT PROGRAM.	C PRPCOM
DSIP(L)	DECREASE IN ENTROPY FROM PREVIOUS STATION TO CURRENT STATION L AT BOUNDARY LAYER EDGE DUE TO SHOCK CURVATURE (DSIP(1)= 0 BY DEFINITION).	C EDGCOM
DSQ(I)	(DETA(I))**2	C ETACOM
DSV	LOCALLY DEFINED VARIABLE	L MATS1
DTD	DOWNWARD TEMPERATURE STEP USED IN SEEKING SURFACE EQUILIBRIUM SOLUTION.	L EQUIL
DTEMP	PREDICTED CHANGE IN SURFACE TEMPERATURE FOR THE CURRENT ITERATION DURING A KR(9)=6 PROBLEM.	L NONCER
DTH	DERIVATIVE OF T WITH RESPECT TO H.	C PRPCOM
DTHW	DTH EVALUATED AT THE WALL.	C NONCOM

DTK(K)	DERIVATIVE OF T WITH RESPECT TO MASS FRACTION OF ELEMENT K.	C	PRPCOM
DTKW(K)	DTK EVALUATED AT THE WALL.	C	NONCOM
DTM	LIMIT VALUE OF DELTA (1./T) IN CHEMISTRY SOLUTION.	L	CRECT
DTU	UPWARD TEMPERATURE STEP USED IN SEEKING SURFACE EQUILIBRIUM SOLUTION.	L	EQUIL
DUB2	LOCALLY INPUT VARIABLES, IF NON-ZERO ASSIGNED TO FITMOL, BASMOL, SIGMA AND EPOVRK, RESPECTIVELY	L	INPUT
DUB3		L	INPUT
DUB4		L	INPUT
DUB5		L	INPUT
DUDS(L)	DERIVATIVE OF EDGE VELOCITY WITH RESPECT TO S IN REFCON, TEMPORARY STORAGE AREA IN OTHER ROUTINES.	C	TEMCOM
DUEDGE	DERIVATIVE UEDGE WITH RESPECT TO STREAM FUNCTION, SEE EQ(68 OF NASA CR-1062 (SET EQUAL TO ZERO IN PRESENT PROGRAM).	C	EDGCOM
DUES	DERIVATIVE OF EDGE VELOCITY WITH RESPECT TO STREAMWISE COOR DINATE S.	C	EDGCOM
DUM	LOCALLY DEFINED VARIABLE	L	EQUIL
DUM	LOCALLY DEFINED VARIABLE	L	ETIMEF
DUM	LOCALLY DEFINED VARIABLE	L	FIRSTG
DUM	LOCALLY DEFINED VARIABLE	L	KINET
DUM	LOCALLY DEFINED VARIABLE	L	MATS1
DUM	LOCALLY DEFINED VARIABLE	L	NONCER
DUM	LOCALLY DEFINED VARIABLE	L	TRMBL
DUM1	LOCALLY DEFINED VARIABLE	L	CRECT
DUM1	LOCALLY DEFINED VARIABLE	L	EQUIL
DUM1	LOCALLY DEFINED VARIABLE	L	FIRSTG
DUM1	LOCALLY DEFINED VARIABLE	L	ICOEFF
DUM1	LOCALLY DEFINED VARIABLE	L	IMONE
DUM1	LOCALLY DEFINED VARIABLE	L	IONLY
DUM1	LOCALLY DEFINED VARIABLE	L	KINET
DUM1	LOCALLY DEFINED VARIABLE	L	LINCER
DUM1	LOCALLY DEFINED VARIABLE	L	MATER

DUM1	LOCALLY DEFINED VARIABLE	L NONCER
DUM1	LOCALLY DEFINED VARIABLE	L OUTPUT
DUM1	LOCALLY DEFINED VARIABLE	L REFCON
DUM1	LOCALLY DEFINED VARIABLE	L RNLCER
DUM1	LOCALLY DEFINED VARIABLE	L TRMBL
DUM2	LOCALLY DEFINED VARIABLE	L EQUIL
DUM2	OCALLY DEFINED VARIABLE	L FIRSTG
DUM2	LOCALLY DEFINED VARIABLE	L ICOEFF
DUM2	LOCALLY DEFINED VARIABLE	L IMONE
DUM2	LOCALLY DEFINED VARIABLE	L IONLY
DUM2	LOCALLY DEFINED VARIABLE	L KINET
DUM2	LOCALLY DEFINED VARIABLE	L LINCER
DUM2	LOCALLY DEFINED VARIABLE	L MATER
DUM2	LOCALLY DEFINED VARIABLE	L OUTPUT
DUM2	LOCALLY DEFINED VARIABLE	L RNLCER
DUM2	LOCALLY DEFINED VARIABLE	L TRMBL
DUM3	LOCALLY DEFINED VARIABLE	L FIRSTG
DUM3	LOCALLY DEFINED VARIABLE	L IMONE
DUM3	LOCALLY DEFINED VARIABLE	L IONLY
DUM3	LOCALLY DEFINED VARIABLE	L LINCER
DUM3	LOCALLY DEFINED VARIABLE	L OUTPUT
DUM3	LOCALLY DEFINED VARIABLE	L TRMBL
DUM4	LOCALLY DEFINED VARIABLE	L IMONE
DUM4	LOCALLY DEFINED VARIABLE	L IONLY
DUM4	LOCALLY DEFINED VARIABLE	L LINCER
DUM4	LOCALLY DEFINED VARIABLE	L OUTPUT
DUM5	LOCALLY DEFINED VARIABLE	L IMONE
DUM5	LOCALLY DEFINED VARIABLE	L IONLY

DUM5	LOCALLY DEFINED VARIABLE	L LINCER
DUM6	LOCALLY DEFINED VARIABLE	L IMONE
DUM6	LOCALLY DEFINED VARIABLE	L LINCER
DUM7	LOCALLY DEFINED VARIABLE	L IMONE
DUM8	LOCALLY DEFINED VARIABLE	L IMONE
DUMP	P * 10**7, LIMIT PRESSURE IN CONTROLLING DAMPING OF CHEMISTRY SOLUTION.	L CRECT
DUZ	LOCALLY DEFINED VARIABLE	L OUTPUT
DVNL(N)	DAMPED NONLINEAR CORRECTIONS (GIVEN BY EQ(156) OF NASA CR-1062 MULTIPLIED BY EASE).	C NONCOM
DY(J)	CORRECTION ON VARIABLE Y(J)* IN CHEMISTRY SOLUTION.	C EQTCOM
DVS	VELOCITY DEFECT THICKNESS OVER DEL.	C EPSCOM
DYI	DAMPED CORRECTION ON VARIABLE Y(J)* IN CHEMISTRY SOLUTION.	L CRECT
DZ	THE D SUB ZERO OF EQ(89) IN NASA CR-1062.	L HISTXI
DZKH(K)	DERIVATIVE OF ZK WITH RESPECT TO H.	C PRPCOM
DZKK(K,KK)	DERIVATIVE OF K TH ZK WITH WITH RESPECT TO MASS FRACTION OF ELEMENT KK.	C PRPCOM
E(N)	ERRORS IN CHEMISTRY EQUATIONS (MASS BALANCE ERRORS FOR N EQUAL TO OR LESS THAN IS*, EQUILIBRIUM ERRORS FOR N GREATER THAN IS*, WHERE IS* IS NUMBER OF ELEMENTS INCLUDING ELECTRON).	C EQTCOM
EAB	ABSOLUTE VALUE OF EQUILIBRIUM ERROR FOR A SPECIES IN CHEMISTRY SOLUTION.	L MATER
EAK(MK)	ACTIVATION ENERGY.	C KINCOM
EASE	DAMPING FACTOR, APPLIED UNIFORMLY TO ALL CORRECTIONS.	C BUMCOM
EB(K)	MAGNITUDE OF LARGEST CONTRIBUTION TO K TH MASS BALANCE.	C EQTCOM
EBL(K)	MINIMUM CONTRIBUTION ACCEPTED TO K TH MASS BALANCE, =EB/(10**8)	C EQTCOM
ECD(N)	RESIDUAL ERROR IN CONDENSED EQUILIBRIUM IMPOSED IN CHEMISTRY SOLUTION AS A CONSEQUENCE OF BOUNDARY LAYER DAMPING.	L MATER
ECRP	LIMIT CHANGE OF CONDENSED SPECIES QUANTITIES DURING CHEMISTRY ITERATION.	C EQTCOM
ECRT	NOT CURRENTLY USED.	C EQTCOM

EDGEQV	VARIABLE EQUIVALENCED TO EDGCOM FOR DUMPING PURPOSES	L DUMCOM
EER	EQUILIBRIUM ERROR OF CONDENSED SPECIES BEING INTRODUCED DURING CURRENT ITERATION.	L MATER
EESE(N)	RESIDUAL ERROR IN MASS BALANCE IMPOSED IN CHEMISTRY SOLUTION AS A CONSEQUENCE OF BOUNDARY LAYER DAMPING.	L MATER
EG2	CONTRIBUTION TO THERMAL FLUX DUE TO INEQUALITY OF TURBULENT PRANDTL AND SCHMIDT NUMBERS	L TRMBL
EG3	CONTRIBUTION TO THERMAL FLUX DUE TO TURBULENT VISCOUS DISSIPATION	L TRMBL
EHS	ERROR IN ENTHALPY OR ENTROPY FOR ASSIGNED ENTHALPY OR ENTROPY CHEMISTRY SOLUTIONS.	L MATER
EL	MAXIMUM EQUILIBRIUM ERROR, IDENTICAL TO EEL+.	C EQTCOM
EL(I)	MIXING LENGTH NORMALIZED BY DEL.	C EPSCOM
ELCON	MIXING LENGTH CONSTANT AS IN L=ELCON*Y.	C EPSCOM
ELK	LOG OF EQUILIBRIUM IMBALANCE OF KINETIC REACTION.	L KINET
ELKM	LOG OF NON-EQUILIBRIUM OF KINETIC RELATION	L KINET
ELM(N)	GLOBAL SET OF MAXIMUM VALUES OF ERRORS FOR VARIOUS SETS OF TAYLOR SERIES EXPANSIONS.	C ERRCOM
ELMM	MAXIMUM VALUE OF ELM(N).	C ERRCOM
EMIS	SURFACE EMITTANCE OF THE MATERIAL BEING CONSIDERED UNDER KR(9) = 3,4,5 OR 6.	C CRBCOM
EMISC	SURFACE EMITTANCE OF THE MATERIAL BEING CONSIDERED UNDER KR(9) = 3 OR 4.	C CRBCOM
EMIST	SURFACE EMITTANCE OF THE MATERIAL BEING CONSIDERED UNDER KR(9) = 5 OR 6.	C CRBCOM
EMIV	SURFACE EMISIVITY	C CRBCOM
ENL	MAXIMUM MASS BALANCE ERROR, IDENTICAL TO EENL+.	C EQTCOM
ENL(N)	GLOBAL SET OF ERRORS FOR LINEARIZED CONSERVATION EQUATIONS AND BOUNDARY CONDITIONS.	C ERRCOM
ENLM(N)	GLOBAL SET OF MAXIMUM VALUES OF ERRORS FOR THE VARIOUS SETS OF LINEARIZED CONSERVATION EQUATIONS AND BOUNDARY CONDITIONS.	C ERRCOM
ENLMM	LARGEST VALUE OF ENLM.	C ERRCOM
EOL	MULTIPLYING FACTOR USED TO SMOOTHLY TRANSFORM KINETIC MASS BALANCE TO EQUIVALENT EQUILIBRIUM EQUATION.	L KINET

EP	ERROR IN OVERALL PRESSURE BALANCE.	L MATER
EPSA(I)	RHO(I)**2*(EDDY VISCOSITY)/(RHOE(L)*VMUE(L)).	C EPSCOM
EPI	LOCALLY DEFINED VARIABLE	L TRMBL
EPOVRK	EPSILON/K, OF REFERENCE SPECIES IN DIFFUSION CALCULATIONS	C EQTCOM
EPS	KINEMATIC EDDY VISCOSITY	L TRMBL
EPS1	KINEMATIC EDDY VISCOSITY IN WALL REGION	C EPSCOM
EPS2	KINEMATIC EDDY VISCOSITY IN WAKE REGION	L TRMBL
EPSOUT	VARIABLE EQUIVALENCED TO EPSCOM FOR OUTPUT PURPOSES	L TRMBL
EQPEQV	VARIABLE EQUIVALENCED TO EQPCOM FOR DUMPING PURPOSES	L DUMCOM
EQTEQV	VARIABLE EQUIVALENCED TO EQTCOM FOR DUMPING PURPOSES	L DUMCOM
ER	ERROR IN MASS BALANCE RELATION.	L MATER
ERPP1	DERIVITIVE OF DAWSON FUNCTION WITH RESPECT OT ITS ARGUMENT AT I	L TRMBL
ERPP2	DERIVITIVE OF DAWSON FUNCTION WITH RESPECT TO ITS ARGUMENT AT I-1	L TRMBL
ERP1	DAWSON FUNCTION OF ARGUMENT AT I	L TRMBL
ERP2	DAWSON FUNCTION OF ARGUMENT AT I-1	L TRMBL
ERREQV	VARIABLE EQUIVALENCED TO ERRCOM FOR DUMPING PURPOSES	L DUMCOM
ETA(I)	TRANSFORMED COORDINATE IN A DIRECTION NORMAL TO THE SURFACE DEFINED BY EQ (33) OF NASA CR-1062.	C ETACOM
ETAEQV	VARIABLE EQUIVALENCED TO ETACOM FOR DUMPING PURPOSES	L DUMCOM
ETAT	LOCALLY DEFINED VARIABLE	L FIRSTG
EXEL	RATIO OF FORWARD TO REVERSE DRIVING POTENTIAL IN KINETIC EQUATIONS.	L KINET
EXK(MK)	ALWAYS SET TO 1.0, (REACTION EXPONENT).	C KINCOM
F(N,I)	STREAM FUNCTION (N=1), VELOCITY RATIO (N=2) AND DERIVATIVES OF ORDER N-2 OF VELOCITY RATIO WITH RESPECT TO ETA.	C VARCOM
FAMOA(J)	ALPHANUMERIC VARIABLE, FIRST OF TWO PORTIONS OF SPECIES NAME. IDENTICAL TO MOA+.	C BLQCOM
FAMOB(J)	ALPHANUMERIC VARIABLE, SECOND OF TWO PORTIONS OF SPECIES NAME. IDENTICAL TO MOB+.	C BLQCOM

FD(N)	D1 * F(N+1,I) + D2 * HF(I,N+1) FOR N=1 THROUGH 3, D1 * F(4, I-1)+D2 * HF(I-1,4) FOR N=4.	L	HISTXI
FF(J)	DIFFUSION FACTOR INTRODUCED BY THE APPROXIMATION FOR DIFFUSION COEFFICIENTS BY EQ(19) OF NASA CR-1062.	C	EQPCOM
FFA	POWER ON MOLECULAR WEIGHT IF IT IS ASSUMED THAT THE DIFFUSION FACTORS, FF(J), ARE PROPORTIONAL TO SPECIES MOLECULAR WEIGHTS, WTM(J),RAISED TO A POWER.	C	EQPCOM
FFAR	POWER ON MOLECULAR WEIGHT READ IN IF IT IS ASSUMED THAT THE DIFFUSION FACTORS, FF(J), ARE PROPORTIONAL TO SPECIES MOLECULAR WEIGHTS, WTM(J), RAISED TO A POWER OTHER THAN 0.5	L	INPUT
FFF	RATIO OF GAS MOLECULAR WEIGHT TO 'VMU2'.	L	MATER
FFIN(J)	DIFFUSION FACTOR, FF(J), WHICH IS READ IN.	L	INPUT
FFK2	PARAMETER SET EQUAL TO WM/VMU2 FOR EQUAL DIFFUSION COEFFICIENTS (KKR(14)=2) AND TO FF(K) FOR UNEQUAL DIFFUSION COEFFICIENTS (KKR(14)=0 OR 1).	L	PROPS
FITMOL	CONSTANT IN CURVE FIT OF DIFFUSION FACTORS BASED ON MOLECULAR WEIGHTS	L	INPUT
FKF(MK)	PRE-EXPONENTIAL FACTOR,POUND MOLES OF REACTANT PER SECOND PER FT**2.	C	KINCOM
FLD(N,NN)	CURVE FIT CONSTANTS FOR THERMODYNAMIC DATA FOR THE FLUID MIXTURE IN KR(7)=1 OPTION (SIMILAR TO THE QUANTITIES DISCUSSED IN GROUP 12 OF THE INPUT INSTRUCTIONS). NN= 1,2 OR 3 FOR TEMPERATURE RANGES LESS THAN 3600 DEG R, EQUAL TO OR GREATER THAN 3600 DEG R BUT LESS THAN 5400 DEG R, OR, EQUAL TO OR GREATER THAN 5400 DEG R, RESPECTIVELY. N REFERS TO COMPONENT OF THE NONREACTING FLUID MIXTURE.	C	STTCOM
FLE(N)	ERROR FOR THE TAYLOR SERIES EXPANSIONS INVOLVING F(1,I) AND THEIR DERIVATIVES.	C	ERRCOM
FLEM	MAXIMUM VALUE OF FLE(N).	C	ERRCOM
FLIQ	FRACTION OF A SPECIES WHICH IS LIQUID.	C	EQTCOM
FLPEQV	VARIABLE EQUIVALENCED TO FLPCOM FOR DUMPING PURPOSES	L	DUMCOM
FLUXJ (N,L,1)	CONVERGED VALUE FOR MASS FLUX OF COMPONENT N INTO THE BOUNDARY LAYER AT THE WALL, N 1 TO 3 FOR EDGE GAS, PYROLYSIS GAS AND CHAR, RESPECTIVELY.	C	WALCOM
FLXEQV	VARIABLE EQUIVALENCED TO FLXCOM FOR DUMPING PURPOSES	L	DUMCOM
FM(J)	3 IF UNIMPORTANT SPECIES (NOT SIGNIFICANT IN ANY MASS BALANCE), OTHERWISE 1.	C	EQTCOM
FN	LOCALLY DEFINED VARIABLE	L	ERP

FNLEM	ERROR FOR THE LINEARIZED MOMENTUM EQUATIONS AND BOUNDARY CONDITIONS.	C ERRCOM
FNU(K)	VNU(J,K) FOR CURRENT J.	C EQTCOM
FPPW	F(3,1) PRINTED IN ONE-LINE-PER-ITERATION OUTPUT.	L ITERAT
FR(J,I)	MOLE FRACTION.	C BLQCOM
FW(L,1)	CONVERGED VALUE OF STREAM FUNCTION AT SURFACE OF BODY.	C WALCOM
FWCON(L)	INTEGRAND IN CALCULATION OF FW IN REFCON, TEMPORARY STORAGE AREA IN OTHER ROUTINES.	C TEMCOM
FWDUM(L)	FW * SQRT(2*XI) IN REFCON, TEMPORARY STORAGE AREA IN OTHER ROUTINES.	C TEMCOM
G(N,I)	TOTAL ENTHALPY (N=1) AND ITS DERIVATIVES OF ORDER N-1 WITH RESPECT TO ETA.	C VARCOM
GAM	ISENTROPIC EXPONENT.	L EQUIL
GAM1	ISENTROPIC EXPONENT FOR HOMOGENEOUS MIXTURE	C STTCOM
GAMF(K)	DEFINED BY EQ(79) OF NASA CR-1064.	C EQTCOM
GAMH(K)	DEFINED BY EQ(80) OF NASA CR-1064.	C EQTCOM
GAMK(K,KK)	DEFINED BY EQ (81) OF NASA CR-1064.	E NONCOM
GD(N)	D1 * G(N,I) + D2 * HG(I,N) FOR N=1 THROUGH 3, D1 * G(3,I-1) + D2 *HG(I-1,3) FOR N=4.	L HISTXI
GE(M)	STAGNATION ENTHALPY AT BOUNDARY LAYER EDGE.	C PRMCOM
GLE(N)	ERROR FOR THE TAYLOR SERIES EXPANSIONS INVOLVING G(1,I) AND THEIR DERIVATIVES.	C ERRCOM
GLEM	MAXIMUM VALUE OF GLE(N).	C ERRCOM
GMR	ISENTROPIC EXPONENT FROM EQUILIBRIUM CALCULATION	C PRPCOM
GNLEM	ERROR FOR THE LINEARIZED ENERGY CONSERVATION EQUATIONS.	C ERRCOM
GW	FIRST GUESS FOR WALL ENTHALPY WHICH IS READ IN WHEN KR(2)=0	L FIRSTG
H(I)	STATIC ENTHALPY OF THE MIXTURE, IDENTICAL TO HH*.	C PRPCOM
H(J)	ENTHALPY, IDENTICAL TO HH+.	C EQTCOM
HALPH	STORED (HISTORIC) VALUE OF ALPH ONE STATION UPSTREAM.	C HISCOM
HCARB	HEAT OF FORMATION AT 298 DEG. K OF THE SURFACE MATERIAL BEING CONSIDERED UNDER KR(9) = 3 OR 4.	C CRBCOM
HCH	CHAMBER (OR STAGNATION) ENTHALPY.	L EQUIL

HCHAR	CHAR ENTHALPY	C CRBCOM
HCWAL	ENTHALPY OF SURFACE SPECIES DURING KR(9) = 3 OR 4 OPTIONS.	C EQPCOM
HE	STATIC ENTHALPY OF GAS AT BOUNDARY-LAYER EDGE.	C EDGCOM
HET	TOTAL ENTHALPY OF GAS AT BOUNDARY-LAYER EDGE.	L STATE
HF(I,N)	STORED (HISTORIC) VALUE OF F(N,I) ONE STATION UPSTREAM FOR N=1 THROUGH 4, HF(I,5) = D1*F(1,I) + D2*HF(I,1) WHERE D1 AND D2 ARE DEFINED BY EQ(88) OR (89) OF NASA CR-1062.	C HISCOM
HG	ENTHALPY OF GAS, IDENTICAL TO HHG+.	C EQTCOM
HG(I,N)	STORED (HISTORIC) VALUE OF G(N,I) ONE STATION UPSTREAM.	C HISCOM
HH(I)	STATIC ENTHALPY OF THE MIXTURE, IDENTICAL TO H+.	C PRPCOM
HH(J)	ENTHALPY, IDENTICAL TO H(J)*.	C EQTCOM
HIP	ENTHALPY INPUT.	C EQTCOM
HISEQV	VARIABLE EQUIVALENCED TO HISCOM FOR DUMPING PURPOSES	L DUMCOM
HIST1(N)	SET OF VARIABLES STARTING WITH XI(1) TO BE STORED ON TAPE.	E HISCOM
HIST2(N)	SET OF VARIABLES STARTING WITH PE(1,1) TO BE STORED ON TAPE	E EDGCOM
HIST3(N)	SET OF VARIABLES STARTING WITH F(1,1) TO BE STORED ON TAPE.	E VARCOM
HIST4(N)	SET OF VARIABLES STARTING WITH FW(1,1) TO BE STORED ON TAPE	E WALCOM
HM(J)	ENTHALPY OF FUSION.	C EQPCOM
HMAT	HEAT OF FORMATION AT 298 DEG. K OF THE MATERIAL BEING CON- SIDERED UNDER KR(9) = 3,4,5 OR 6.	C CRBCOM
HMELT	HM(J) IF J TH SPECIES IS CHANGING PHASE, OTHERWISE 0.	C EQTCOM
HOS	ENTHALPY OR ENTROPY OF SPECIES IN ASSIGNED ENTHALPY OR EN- TROPY CHEMISTRY SOLUTION.	L MATER
HP	DERIVATIVE OF H WITH RESPECT TO ETA.	C PRPCOM
HPG	HEAT OF FORMATION AT 298 DEG. K OF THE PYROLYSIS GAS BEING CONSIDERED UNDER KR(9) = 3 OR 4.	C CRBCOM
HPYG	PYROLYSIS GAS ENTHALPY	C CRBCOM
HSP(I,N,K)	STORED (HISTORIC) VALUE OF SP(N,I,K) ONE STATION UPSTREAM.	C HISCOM
HTEF	HEAT OF FORMATION AT 298 DEG. K OF THE MATERIAL BEING CON- SIDERED UNDER KR(9) = 5 OR 6.	C CRBCOM
HTIL	PROPERTY OF THE GAS MIXTURE WHICH REDUCES TO H(I) FOR EQUAL DIFFUSION COEFFICIENTS, SEE EQ(28) OF NASA CR-1062.	C PRPCOM

HTILP	DERIVATIVE OF HTIL WITH RESPECT TO ETA.	C PRPCOM
HW(L,1)	CONVERGED ENTHALPY OF GAS AT THE WALL.	C WALCOM
I	INDEX ON ETA, I=1, AT WALL, IDENTICAL TO II*.	
I1	LOCAL INDEX	L KINET
I777	VARIABLE TO CHECK IF SUBROUTINE HAS PREVIOUSLY BEEN ENTERED	C BUMCOM
IAST	ASSIGNED THE VALUE COMMA (,) THROUGH A DATA STATEMENT FOR USE IN TEST OF WHETHER THERE IS TO BE ANOTHER CASE.	L BLIMP
IB(K)	INDEX ON SPECIES WITH LARGEST CONTRIBUTION TO K TH MASS BAL ANCE, SUBSEQUENTLY ORDERED ON IB WITH DUPLICATES SET TO 1000.	C EQTCOM
IBLANK	ASSIGNED THE VALUE BLANK ( ) THROUGH A DATA STATEMENT FOR USE IN TEST OF WHETHER THERE IS TO BE ANY PUNCHED CARD OUT- PUT.	L OUTPUT
IC(K)	NEGATIVE INDEX OF ELEMENT CORRESPONDING TO KTH BASE SPECIES	L INPUT
ICORM	INDEX CORRESPONDING TO CORMA IN THE CORAR ARRAY.	C BUMCOM
ICT	CYCLE COUNTER ON POST INVERSION MODIFICATION IN CHEMISTRY SOLUTION	L EQUIL
IDENT	ALPHANUMERIC IDENTIFICATION SYMBOL APPEARING ON PUNCHED CARD DATA (NO CARDS PUNCHED IF IDENT IS INPUT AS A BLANK).	C INTCOM
IDISC(L)	CONTROL VARIABLE FOR DISCONTINUITY (1 IF DISCONTINUITY, OTHERWISE 0).	C PRMCOM
IDSIP	ITEM WHEN DSIP IS TO BE UPDATED.	C EDGCOM
IDUM	LOCALLY DEFINED VARIABLE	L SETUP
IE	EQUATION INDEX FOR CONDENSED SPECIES.	L MATER
IENLM	INDICIES ON MAXIMUM NON LINEAR ERRORS FOR EACH SET OF CONSERVATION EQUATIONS	L RNLCER
IENLM	INDICIES ON MAXIMUM NON LINEAR ERRORS FOR EACH SET OF CONSERVATION EQUATIONS	L NONCER
IER	EQUATION NUMBER TO REPRESENT NEWLY APPEARING CONDENSED SPE- CIES.	C EQTCOM
IFC(J)	CONTROL FLAG (0 GAS, -1 NONPRESENT CONDENSED, +1 PRESENT CONDENSED, PRIOR FLAGS DECREMENTED BY 3 IF SPECIES CONTAINS NONPRESENT ELEMENT OR INCREMENTED BY 3 IF IT IS A BASE SPE- CIES REPRESENTING A NONPRESENT ELEMENT).	C EQPCOM
IFLM	INDEX OF THE SET OF LINEAR EQUATIONS WHICH HAS THE LARGEST ERROR FLEM.	C ERRCOM

IFLUXJ	ITEM WHEN FLUXJ IS TO BE UPDATED.	C WALCOM
IFN	INDEX ON LINEAR VARIABLE F(1,I)	L IMONE
IFN	INDEX ON LINEAR VARIABLE F(1,I)	L IONLY
IFNLM	INDEX OF THE LINEARIZED MOMENTUM EQUATION WHICH HAS THE LARGEST ERROR FNLEM.	C ERRCOM
IFP	INDEX ON NON-LINEAR VARIABLE F(2,I)	L IMONE
IFP	INDEX ON NON-LINEAR VARIABLE F(2,I)	L IONLY
IFPP	INDEX ON LINEAR VARIABLE F(3,I)	L IMONE
IFPP	INDEX ON LINEAR VARIABLE F(3,I)	L IONLY
IFPPP	INDEX ON LINEAR VARIABLE F(4,I)	L IMONE
IFPPP	INDEX ON LINEAR VARIABLE F(4,I)	L IONLY
IFW	ITEM WHEN FW IS TO BE UPDATED.	C WALCOM
IG	NOMINALLY ZERO, EQUALS ONE ON FIRST SET OF BOUNDARY LAYER CHEMISTRY SOLUTIONS. FIRST GUESS AT I+ IS SOLUTION AT I-IG.	L EQUIL
IG	ELIMINATION INDEX IN BASE SPECIES-ELEMENT CORRESPONDENCE LOGIC.	L INPUT
IGLM	INDEX OF THE SET OF LINEAR EQUATIONS WHICH HAS THE LARGEST ERROR GLEM.	C ERRCOM
IGNLM	INDEX OF THE LINEARIZED ENERGY CONSERVATION EQUATION WHICH HAS THE LARGEST ERROR GNLEM.	C ERRCOM
IHW	ITEM WHEN HW IS TO BE UPDATED.	C WALCOM
II	INDEX ON ETA, II=1 AT WALL, IDENTICAL TO I+.	C INTCOM
IIS	LOCAL INDEX	L RECASE
IJ	LOCAL INDEX	L PROPS
IK	LOCAL INDEX	L PROPS
IL	INDEX ON FIRST CHEMISTRY EQUATION TO BE SOLVED (1 FOR UN- KNOWN T AND 2 FOR KNOWN T).	C EQTCOM
ILMM	INDEX OF THE LINEAR EQUATION WHICH HAS THE LARGEST ERROR ELMM.	C ERRCOM
IM(K)	ROW AND COLUMN INDEX IN INVERSION OF CIJ TO UM.	L INPUT
IMI	LOCAL INDEX	L INPUT

IMJ	LOCAL INDEX	L INPUT
IML	LOCAL INDEX	L INPUT
IN	NUMBER OF EQUATIONS BEING SOLVED (HAS THE VALUE OF THE LOCAL VARIABLE ISPQ IF TEMPERATURE IS UNKNOWN OR ISPQ-1 IF TEMPERATURE IS KNOWN).	C EQTCOM
INLMM	INDEX OF THE NONLINEAR EQUATION WHICH HAS THE LARGEST ERROR ENLMM.	C ERRCOM
INP	IN+2	L CRECT
IPRE	ITEM WHEN PRE IS TO BE UPDATED.	C PRMCOM
INTEQV	VARIABLE EQUIVALENCED TO INTCOM (EXCEPT KR(20)) FOR DUMPING PURPOSES	L DUMCOM
INV	FLAG ON RESTART OF CHEMISTRY (PERMITS ONLY ONE RESTART)	L EQUIL
IQ	FOR EACH NON-BASE GASEOUS SPECIES INITIALIZED TO ZERO, SET TO ONE IF SPECIES IS SIGNIFICANT IN ANY MASS BALANCE.	L MATER
IQQ	DEBUG(-2) AND NONCONVERGENT(-1) FLAG ON CALL TO AND RETURN FROM RERAY, RESPECTIVELY.	L EQUIL
IR(K)	CORRESPONDENCE VECTOR BETWEEN BASE SPECIES AND ELEMENTS.	C EQPCOM
IRAD	ITEM WHEN RADR IS TO BE UPDATED.	C PRMCOM
IRE	INDEX ON NEWLY APPEARING CONDENSED SPECIES.	C EQTCOM
IRHOVW	ITEM WHEN RHOVW IS TO BE UPDATED.	C WALCOM
IS	NUMBER OF ELEMENTS INCLUDING ELECTRON, IDENTICAL TO IZ+.	C EQPCOM
IS	INDEX ON S, IS=1 AT STAGNATION POINT OR LEADING EDGE, IDENTICAL TO ISS*.	C INTCOM
ISM	NSP-1	L PROPS
ISP	NUMBER OF ELEMENTS INCLUDING ELECTRON PLUS ONE.	C BUMCOM
ISP	SAME AS ISP IN INPUT.	L EQUIL
ISP	(IS*) + 1 WHERE IS* IS THE NUMBER OF ELEMENTS INCLUDING ELECTRON.	L INPUT
ISP	NSP + 1	L PROPS
ISP2	NUMBER OF ELEMENTS INCLUDING ELECTRON PLUS TWO.	C KINCOM
ISP2	NSP + 2	L PROPS
ISPLM(K)	INDEX OF THE SET OF LINEAR EQUATIONS WHICH HAS THE LARGEST ERROR SPLEM(K).	C ERRCOM

ISPN	INDEX ON NON-LINEAR VARIABLE (G(1,I) OR SP(1,I,K))	L	IMONE
ISPN	INDEX ON NON-LINEAR VARIABLE (G(1,I) OR SP(1,I,K))	L	IONLY
ISPNLM(K)	INDEX OF THE LINEARIZED ELEMENTAL CONSERVATION EQUATION WHICH HAS THE LARGEST ERROR SPNLEM(K).	C	ERRCOM
ISPP	INDEX ON LINEAR VARIABLE (G(2,I) OR SP(2,I,K))	L	IMONE
ISPP	INDEX ON LINEAR VARIABLE (G(2,I) OR SP(2,I,K))	L	IONLY
ISPPP	INDEX ON LINEAR VARIABLE (G(3,I) OR SP (3,I,K))	L	IMONE
ISPPP	INDEX ON LINEAR VARIABLE (G(3,I) OR SP (3,I,K))	L	IONLY
ISPQ	ISP2 + NUMBER OF PRESENT CONDENSED SPECIES.	C	KINCOM
ISPQ	NUMBER OF EQUATIONS SOLVED IN CHEMISTRY SOLUTIONS, IS+2+ NUMBER OF PRESENT CONDENSED SPECIES.	L	EQUIL
ISPW	ITEM WHEN SPW IS TO BE UPDATED.	C	WALCOM
ISS	INDEX ON S, ISS=1 AT STAGNATION POINT OR LEADING EDGE, IDENTICAL TO IS+.	C	INTCOM
IST	LOCAL INDEX	L	FIRSTG
ISU	INDEX OF SPECIES REPRESENTATIVE OF SURFACE	C	CRBCON
ISV	ISV IS SET EQUAL TO IS* NEAR BEGINNING OF SUBROUTINE PROPS IS* THEN BEING SET TO NSP. IS* RESTORED TO ISV AT THE END OF PROPS.	L	PROPS
ISV2	LOCALLY DEFINED VARIABLE	L	PROPS
ISVP	ISV+1	L	PROPS
IT	NOT USED IN CURRENT VERSION, IDENTICAL TO IIT+.	C	[illegible]TCOM
IT	CURRENTLY SET TO UNITY, IDENTICAL TO ITT*.	C	[illegible]M
ITEM	TIME (OR SUBCASE).	C	[illegible]COM
ITFF	NEGATIVE COUNT ON SUCCEEDING CHEMISTRY SOLUTIONS WHICH WILL ACCEPT RESIDENT SOLUTION AS FIRST GUESS.	L	EQUIL
ITS	COUNTER FOR CHEMISTRY ITERATIONS, IDENTICAL TO IITS+.	C	EQTCOM
ITS	COUNTER FOR BOUNDARY LAYER ITERATIONS, IDENTICAL TO MITS*.	C	INTCOM
ITT	CURRENTLY SET TO UNITY, IDENTICAL TO IT+.	C	INTCOM
ITW	ITEM WHEN TW IS TO BE UPDATED.	C	WALCOM
IX	VARIABLE IN RERAY CALL SEQUENCE HAVING TO DO WITH PRINTING OF DEBUG OUTPUT, -2 GIVES DEBUG, COMES BACK 3 IF INVERSION SUCCEEDED, 1 IF SINGULAR.	C	BUMCOM

IX	DIAGNOSTIC FLAG PREVIOUSLY USED TO INDICATE TYPE OF BAD INPUT DETECTED.	L INPUT
IX	DEBUG FLAG.	L RERAY
IZ	NUMBER OF ELEMENTS INCLUDING ELECTRON, IDENTICAL TO IS*.	C EQPCOM
J	LOCAL INDEX	L ABMAX
J	LOCAL INDEX	L CRECT
J	LOCAL INDEX	L EQUIL
J	LOCAL INDEX	L FIRSTG
J	LOCAL INDEX	L HISTXI
J	LOCAL INDEX	L ICOEFF
J	LOCAL INDEX	L INPUT
J	LOCAL INDEX	L KINET
J	LOCAL INDEX	L LIAD
J	LOCAL INDEX	L LINMAT
J	LOCAL INDEX	L MATER
J	LOCAL INDEX	L MATS1
J	LOCAL INDEX	L NONCER
J	LOCAL INDEX	L OUTPUT
J	LOCAL INDEX	L PROPS
J	LOCAL INDEX	L RECASE
J	LOCAL INDEX	L REFCON
J	LOCAL INDEX	L RERAY
J	LOCAL INDEX	L RNLCER
J	LOCAL INDEX	L SETUP
J	LOCAL INDEX	L THERM
J	LOCAL INDEX	L TRMBL
JAST	READ IN AS COMMA (,) OR PERIOD (.) FOR TEST OF WHETHER THERE IS TO BE ANOTHER CASE (SEE INPUT INSTRUCTIONS).	L BLIMP

JAT(N)	ATOMIC NUMBER OF AN ELEMENT WHICH CONTAINS ALPT(N) ATOMS IN A SPECIES.	L INPUT
JB	LOCAL INDEX	L MATS1
JC	INDEX ON SURFACE CONDENSED SPECIES.	C EQTCOM
JJ	LOCAL INDEX	L NONCER
JJ	LOCAL INDEX	L REFCON
JJ	LOCAL INDEX	L RERAY
JJ	LOCAL INDEX	L RNLCER
JJ	LOCAL INDEX	L TRMBL
JL	LOCAL INDEX	L TRMBL
JM	J-1, WHERE 'J' IS BASE SPECIES COUNT.	L INPUT
JRHOVW	SET EQUAL TO UNITY IF RHOVW OR FLUXJ ARE READ IN FOR CURRENT TIME, OTHERWISE ZERO.	L REFCON
JT	LOCAL INDEX	L EQUIL
KAPPA	INDEX OF THE NODAL POINT AT WHICH THE VELOCITY RATIO IS FIXED.	C INTCOM
KAT(K)	ATOMIC NUMBER.	C EQPCOM
KIN	NUMBER OF TAPE FROM WHICH DATA IS READ.	C INTCOM
KINEQV	VARIABLE EQUIVALENCED TO KINCOM FOR DUMPING PURPOSES	L DUMCOM
KIP	CONTROL VARIABLE 0 UNLESS PERFORMING ASSIGNED TEMPERATURE CALCULATION DURING KR(9)=6 ENERGY BALANCE PROBLEMS (SEE DEFINITION OF TFZ).	C BUMCOM
KK	LOCAL INDEX	L EQUIL
KK	LOCAL INDEX	L ICOEFF
KK	LOCAL INDEX	L IMONE
KK	LOCAL INDEX	L INPUT
KK	LOCAL INDEX	L IONLY
KK	LOCAL INDEX	L LIAD
KK	LOCAL INDEX	L NONCER
KK	LOCAL INDEX	L RNLCER

KKR(N)	ARRAY OF INPUT INTEGERS WHICH CONTROL THE VARIOUS OPTIONS OF THE PROGRAM, IDENTICAL TO KR+.	C	INTCOM
KOUT	NUMBER OF TAPE ONTO WHICH DATA IS WRITTEN.	C	INTCOM
KPHA(N)	PHASE INDEX FOR A SPECIES, 1=GAS, 2=SOLID, 3=LIQUID.	L	INPUT
KQ(N)	IDENTICAL TO KR(N)* BY TRANSMITTAL THROUGH CALL LISTS OF PROGRAMS EGUIL AND INPUT. ALSO IDENTICAL TO KD(N)*.	C	INTCOM
KR(N)	CONTROL CARD FOR CHEMISTRY CALCULATION (KR(1)IS 0 FOR ASSI-GNED TEMPERATURE, 1 FOR SURFACE EQUILIBRIUM, 2 FOR ASSIGNED ENTHALPY, KR(2) AND KR(3) ARE 1 IF ELEMENT AND SPECIES DATA ARE TO BE READ IN, OTHERWISE 0, KR(4) IS NOT USED, KR(5) IS 0 IF IT IS NOT A BOUNDARY LAYER EDGE SOLUTION, 1 FOR EXPAN-SION, 2 FOR STAGNATION, KR(6) IS 0 FOR BOUNDARY LAYER CALCU LATION, 2 FOR SURFACE MASS BALANCE, KR(7) CONTROLS DEBUG, IDENTICAL TO KZ(N)+.	C	EQPCOM
KR(N)	ARRAY OF INPUT INTEGERS WHICH CONTROL THE VARIOUS OPTIONS OF THE PROGRAM, IDENTICAL TO KKR*.	C	INTCOM
KR2	KKR(2) (FIRST GUESS FLAG) PRESERVES VALUE SINCE KKR(2) IS RESET TO ZERO IN SETUP.	L	EQUIL
KR9(L)	VALUES OF KR(9) WHEN WALL BOUNDARY CONDITIONS ARE TO BE CHANGED AT DOWNSTREAM STATIONS, CURRENT KR(9) ASSIGNMENT MADE NEAR BEGINNING OF SUBROUTINE NONCER.	C	INTCOM
KR17	SAVED VALUE FOR KR(17).	C	INTCOM
KS	SURFACE MATERIAL INDEX (FOR EACH STATION)	C	CRBCOM
L(N)	INDEX ON COLUMNS DURING INVERSION.	L	RERAY
LAM(K,J)	UNITY IF J TH SPECIES CONTAINS K TH ELEMENT, OTHERWISE ZERO	C	EQPCOM
LAR(N)	INDEX USED FOR REARRANGING ELEMENTS IN MATRIX OF NONLINEAR EQUATIONS (AM).	C	ETACOM
LAST	ASSIGNED THE VALUE PERIOD (.) THROUGH A DATA STATEMENT FOR USE IN TEST OF WHETHER THERE IS TO BE ANOTHER CASE.	L	BLIMP
LEF(K)	FLAG REGARDING MISSING ELEMENTS FOR CURRENT SOLUTION, 3 AL-WAYS PRESENT FROM EDGE, 2 ALWAYS PRESENT DUE TO UPSTREAM INJECTION, 1 PRESENT DUE TO LOCAL INJECTION, 0 NOT PRESENT.	C	BLQCOM
LEFS(K)	FLAG REGARDING MISSING ELEMENTS FROM PRIOR SOLUTION, SEE LEF FOR NUMERICAL VALUES.	C	BLQCOM
LEFT(K,N)	TEMPORARY STORAGE FOR LEF(K) DURING TAPE FLIP-FLOP FOR N = 1 AND 2.	C	
LEFUP	UPDATE LEF IF EQUAL TO ZERO (=MITS+II-2 FOR BOUNDARY LAYER SOLUTION, OTHERWISE=1),	L	EQUIL

LEFW(K)	FLAG REGARDING MISSING ELEMENTS FOR CURRENT WALL SOLUTION. SEE LEF FOR NUMERICAL VALUES.	C BLQCOM
LI	LOCAL INDEX	L LINMAT
LIM(K,KK)	LAM(K,KK) FOR KKTH BASE SPECIES.	L INPUT
LL(MK)	INDEX ON MASS BALANCE WHICH IS CONTROLLED BY N TH KINETIC REACTION.	C KINCOM
LL(N)	ROW INDEX OF PIVOT FOR NTH COLUMN.	L RERAY
LLL(N)	COLUMN INDEX OF PIVOT FOR NTH ROW.	L RERAY
LNZ	LOCAL INDEX	L RECASE
LPI	LOCAL INDEX	L IMONE
LPI	LOCAL INDEX	L IONLY
LPI	LOCAL INDEX	L NONCER
LPI	LOCAL INDEX	L TRMBL
LR	LOCAL INDEX	L TRMBL
LRK	LOCAL INDEX	L TRMBL
LS	INDEX USED TO REARRANGE COLUMNS IN RERAY (SEE LAR)	L RERAY
LSKIP	LOCAL INDEX	L NONCER
L2	INDEX ON PYROLYSIS GAS COMPONENT	C EQTCOM
L3	INDEX ON CHAR COMPONENT	C EQTCOM
M	LOCAL INDEX	L CRECT
M	LOCAL INDEX	L FIRSTG
M	LOCAL INDEX	L HISTXI
M	LOCAL INDEX	L INPUT
M	LOCAL INDEX	L KINET
M	LOCAL INDEX	L LINCER
M	LOCAL INDEX	L MATS1
M	LOCAL INDEX	L NONCER
M	LOCAL INDEX	L REFCON
M	LOCAL INDEX	L RERAY

M	LOCAL INDEX	L RNLCER
M1	COUNT ON PRINCIPAL SPECIES AFTER ORDERING IB.	L CRECT
MA(MK)	ORDERING VECTOR BASED ON HAVING RAT IN DESCENDING SEQUENCE.	C KINCOM
MAT1I	3 * NETA - 2, NUMBER OF TAYLOR SERIES EXPANSIONS AND LINEAR BOUNDARY CONDITIONS INVOLVING F(1,I) AND ITS DERIVATIVES.	C INTCOM
MAT1J	NETA + 3, NUMBER OF LINEARIZED MOMENTUM EQUATIONS AND BOUNDARY CONDITIONS.	C INTCOM
MAT2I	2 * NETA, NUMBER OF TAYLOR SERIES EXPANSIONS AND LINEAR BOUNDARY CONDITIONS INVOLVING G(1,I) AND ITS DERIVATIVES OR THE K TH SPECIES, SP(1,I,K), AND ITS DERIVATIVES.	C INTCOM
MAT2J	NETA, NUMBER OF LINEARIZED ENERGY OR K TH ELEMENTAL CONSERVATION EQUATIONS AND BOUNDARY CONDITIONS.	C INTCOM
MELT	INDEX ON PHASE CHANGING SPECIES.	C EQTCOM
MI	MA(K)	L KINET
MITS	COUNTER FOR BOUNDARY LAYER ITERATIONS, IDENTICAL TO ITS*.	C INTCOM
MM	LOCAL INDEX	L KINET
MM	LOCAL INDEX	L NONCER
MM	LOCAL INDEX	L REFCON
MOA(J)	ALPHANUMERIC VARIABLE, FIRST OF TWO PORTIONS OF SPECIES NAME, IDENTICAL TO FAMOA*.	C BLQCOM
MOB(J)	ALPHANUMERIC VARIABLE, SECOND OF TWO PORTIONS OF SPECIES NAME, IDENTICAL TO FAMOB*.	C BLQCOM
MODE	STORED VALUE FOR KR(1)*.	C EQTCOM
MOE	FLAG SET IN EQUIL AND USED IN CRECT. ZERO RESULTS IN EMPHASIZING EQUILIBRIUM EQUATIONS DURING CHEMISTRY CONVERGENCE, ONE RESULTS IN EMPHASIZING MASS BALANCES.	L EQUIL
MP	INDICES USED IN REARRANGING REACTIVE MASS BALANCES ACCORDING TO CONTROLLING REACTIONS.	L KINET
MPI	LOCAL INDEX	L IMONE
MPI	LOCAL INDEX	L IONLY
MPJ	LOCAL INDEX	L IMONE
MPJ	LOCAL INDEX	L IONLY
MPJ	LOCAL INDEX	L TRMBL

MSD(N)	HAS THE VALUE OF IS AT THE BEGINNING OF N TH REGION BOUNDED BY DISCONTINUITIES (MSD(1)=1 BY DEFINITION) WHERE IS IS INDEX ON S.	C PRMCOM
MT	NUMBER OF KINETICALLY CONTROLLED REACTIONS.	C KINCOM
MWE	CONTROL VARIABLE (-1 FOR NEW CASE, SET TO ZERO AT THE END OF SUBROUTINE SETUP).	C INTCOM
N1	NUMBER OF ROWS + 1	L RERAY
NAM	NUMBER OF NONLINEAR EQUATIONS NOT INCLUDING NONLINEAR WALL BOUNDARY CONDITIONS, NNLEQ-NRNL.	C INTCOM
NBT	NUMBER OF ONE OF TWO TAPES USED IN FLIP-FLOP.	C INTCOM
NBT2	NUMBER OF ONE OF TWO TAPES USED IN FLIP-FLOP.	C INTCOM
NC	NUMBER OF COMPONENTS OF THE NONREACTING FLUID MIXTURE IN KR(7)=1 OPTION.	C STTCOM
NCV	NONCONVERGENCE COUNT, INITIALLY ZERO, INCREMENTED BY ONE FOR EACH NONCONVERGENT CHEMISTRY SOLUTION.	L EQUIL
ND	DIMENSION TRANSMITTED THROUGH CALL	L RERAY
NDISC	NUMBER OF DISCONTINUITIES.	C PRMCOM
NELM	NUMBER OF MAXIMUM LINEAR ERRORS ELM.	C ERRCOM
NENLM	NUMBER OF MAXIMUM NONLINEAR ERRORS ENLM.	C ERRCOM
NETA	NUMBER OF NODAL POINTS ACROSS BOUNDARY LAYER INCLUDING WALL AND EDGE.	C INTCOM
NFF	NUMBER OF SPECIES FOR WHICH DIFFUSION FACTORS, FF(J), ARE TO BE READ IN.	L INPUT
NFIA(J)	FIRST OF TWO PORTIONS OF NAME OF MOLECULE FOR WHICH DIFFU- SION FACTOR, FF(J), IS BEING READ IN.	L INPUT
NFIB(J)	SECOND OF TWO PORTIONS OF NAME OF MOLECULE FOR WHICH DIFFU- SION FACTOR, FF(J), IS BEING READ IN.	L INPUT
NFM	NUMBER OF SIGNIFICANT SPECIES PLUS NUMBER OF NONPRESENT ELEMENTS.	L MATER
NITEM	NUMBER OF TIMES (OR SUBCASES).	C INTCOM
NLEQ	NUMBER OF LINEAR EQUATIONS, MAT1I+NSP*MAT2I.	C INTCOM
NM	NUMBER OF ROWS LESS ONE	L RERAY
NN	NUMBER BY WHICH COLUMNS EXCEED ROWS IN PRINCIPAL ARRAY	L RERAY

NNLEQ	MAT1J + NSP * MAT2J, TOTAL NUMBER OF NONLINEAR EQUATIONS.	C INTCOM
NNN	NUMBER OF COLUMN VECTORS IN SECONDARY ARRAY	L RERAY
NON	CONTROL VARIABLE USED AFTER RETURNING FROM SUBROUTINE OUTPUT (-1 WHEN RERUNNING FROM OUTPUT DURING ITERATIONS, 0 WHEN CONVERGED, +1 WHEN NONCONVERGED AFTER ALLOWED NUMBER OF ITERATIONS).	C INTCOM
NP	NUMBER OF COLUMNS IN PRIMARY ARRAY.	L RERAY
NPR	NUMBER OF DERIVATIVE PROPERTIES TO BE EVALUATED	L PROPS
NRNL	NSP + 1, NUMBER OF REDUCED NONLINEAR EQUATIONS.	C INTCOM
NS	NUMBER OF STREAMWISE STATIONS.	C INTCOM
NSD(N)	NUMBER OF STATIONS CONTAINED IN N TH REGION BOUNDED BY DISCONTINUITIES (S(1) CONSIDERED A DISCONTINUITY IN THIS DEFINITION).	C PRMCOM
NSP	NUMBER OF ELEMENTS IN THE SYSTEM, NOT INCLUDING ELECTRONS.	C INTCOM
NSPEC	NUMBER OF SPECIES, IDENTICAL TO N*.	C BLQCOM
NSPM1	NSP-1	C INTCOM
NTIME	CURRENTLY SET TO UNITY.	C INTCOM
NUL	ZERO.	L HISTXI
N2I	LOCAL INDEX	L NONCER
N7	ITERATION AT WHICH DIAGNOSTIC OUTPUT WILL COMMENCE	L EQUIL
OMEGA	PARAMETER OF THIS NAME USED IN TRANSPORT PROPERTY CALCULATIONS INTRODUCED IN EQ(4) OF NASA CR-1063, NUMERICALLY EQUAL TO 1.07/(T/106.7) ** 0.159	L PROPS
OUTEQV	VARIABLE EQUIVALENCED TO OUTCOM FOR DUMPING PURPOSES	L DUMCOM
P	PRESSURE.	C EQPCOM
PA(K,KK)	PARTIAL DERIVATIVE OF PROPERTY K WITH RESPECT TO LOG T, LOG AA, LOG(Y(KK-2)).	L PROPS
PE(L,1)	STATIC PRESSURE.	C EDGCOM
PHIK(I,K)	SOURCE TERM FOR KTH ELEMENT (EQUAL TO ZERO IN MIXED EQUILIBRIUM-FROZEN BOUNDARY LAYER).	C PRPCOM
PHIKP(K)	DERIVATIVE OF PHIK WITH RESPECT TO ETA.	C PRPCOM
PI	P(I) IN MIXING LENGTH FORMULATION. SEE REF. 1.	C EPSCOM
PID	LOCALLY DEFINED VARIABLE	L TRMBL

PIEASE	PRODUCT OF DAMPING FACTORS.	C BLQCOM
PIM	P AT NODE I-1	L TRMBL
PIN	P * (10**(-5)) USED TO INITIALIZE PARTIAL PRESSURES.	L EQUIL
PIN	SAME AS IN EQUIL.	L MATER
PINL	LOG (PIN).	L EQUIL
PKP(MK)	FORWARD RATE OF REACTION.	C KINCOM
PKR(MK)	REVERSE RATE OF REACTION.	C KINCOM
PLM	SUMMATION VN(J)*WTM(J) FOR ALL CONDENSED SPECIES.	L EQUIL
PMR(MK)	NET FORWARD RATE OF REACTION.	C KINCOM
PMU(K,MK)	STOICHIOMETRIC PRODUCT COEFFICIENT ON K TH BASE SPECIES.	C KINCOM
PMU1	VN(J) * FF(J) SUMMED OVER ALL GASEOUS SPECIES (=VMU1 * P).	L PROPS
PMU2	VN(J) * WTM(J) / FF(J) SUMMED OVER ALL SPECIES N* (=VMU2 * P).	L PROPS
PMU6	VN(J)/(FF(J) * (WD4-VN(J) * FF(J) * WD8)) SUMMED OVER ALL SPECIES N*.	L PROPS
PNUS(K)	SUMMATION VNU(J,K) * VN(J) OVER ALL GASES J.	L MATER
PR(I)	PRANDTL NUMBER.	C PRPCOM
PRA	CONSTANT IN THE PRANDTL NUMBER RELATION DEFINING PR (SEE PRDUM).	C STTCOM
PRB	CONSTANT IN THE PRANDTL NUMBER RELATION DEFINING PR (SEE PRDUM).	C STTCOM
PRC	CONSTANT IN THE PRANDTL NUMBER RELATION DEFINING PR (SEE PRDUM).	C STTCOM
PRD	CONSTANT IN THE PRANDTL NUMBER RELATION DEFINING PR (SEE PRDUM).	C STTCOM
PRDUM	PRANDTL NUMBER IF CONSIDERED CONSTANT, OTHERWISE, IT IS A CONSTANT IN THE RELATION\ PR=PRDUM+PRA * T ** PRB+PRC*T ** PRD, USED IN KR(7)= 1 OPTION ONLY.	C STTCOM
PRE(L)	RATIO OF LOCAL STATIC PRESSURE TO STAGNATION PRESSURE PTET.	C PRMCOM
PREQ	VARIABLE EQUIVALENCED TO PORTION OF PRPCOM FOR STORAGE TRANSFER	L NONCER
PRF	LOCALLY DEFINED VARIABLE	L TRMBL

PRMEQV	VARIABLE EQUIVALENCED TO PRMCOM FOR DUMPING PURPOSES	L DUMCOM
PRMU(K,MK)	PMU-RMU	C KINCOM
PRP	LOCALLY DEFINED VARIABLE RELATIVE TO ARRAY OF DERIVATIVE PROPERTIES BEING CALCULATED	L PROPS
PRPEQV	VARIABLE EQUIVALENCED TO PRPCOM FOR DUMPING PURPOSES	L DUMCOM
PRR	ARGUMENT REPRESENTING PRESSURE	L EQUIL
PRT	TURBULENT PRANDTL NUMBER	C EPSCOM
PTE(L,1)	LOCAL TOTAL PRESSURE.	C EDGCOM
PTET(M)	STAGNATION PRESSURE.	C PRMCOM
PV(N,NN)	DERIVATIVES OF VMU3 (NN=1), VMU4(NN=2),HTIL(NN=3) AND ZK(K) (NN=3+K) WITH RESPECT TO ENTHALPY (N=1),PRESSURE (N=2) AND KTH ELEMENTAL MASS FRACTION (N=2+K).	L PROPS
QA	LOCALLY DEFINED VARIABLE	L SLOPQ
QB	LOCALLY DEFINED VARIABLE	L SLOPQ
QC	LOCALLY DEFINED VARIABLE	L SLOPQ
QI	NUMBER INTRODUCED INTO CALCULATION OF BETAM (WHICH DIFFERS FOR VARIOUS BODY SHAPES) DUE TO CHANGE IN MANNER OF INTEGRATION IN THE VICINITY OF THE STAGNATION POINT OR LEADING EDGE.	L REFCON
QR(I)	NET RADIATION FLUX TOWARD THE SURFACE (SET EQUAL TO ZERO IN BLIMP, COMPUTED BY SUBROUTINE RAD IN RABLE).	C PRPCOM
QS	LOCALLY DEFINED VARIABLE	L TRMBL
QW	DIFFUSIVE HEAT FLUX AT THE WALL, C32/C3 EVALUATED AT WALL.	C FLXCOM
R	LOCALLY DEFINED VARIABLE	L ERP
RA(N)	HEAT OF FORMATION OF MOLECULE AT 298 DEG K FROM JANAF BASE STATE, CAL/MOLE, N=1 OR 2 FOR LOW AND HIGH TEMPERATURE RANGES, RESPECTIVELY.	L INPUT
RADFL(M)	INCIDENT RADIATION FLUX ABSORBED BY THE SURFACE AT STATION S(1).	C PRMCOM
RADNO	ACTUAL NOSE RADIUS OF A SPHERICALLY TIPPED BODY.	C PRMCOM
RADR(L)	RATIO OF INCIDENT RADIATION FLUX ABSORBED BY THE SURFACE TO THE VALUE AT STATION S(1), RADFL.	C PRMCOM
RADS(L)	INCIDENT RADIATION FLUX ABSORBED BY THE SURFACE.	C PRMCOM

RAT(MK)	LARGEST OF PKP, PKR, PMR. MEASURE OF REACTION IMPORTANCE.	C	KINCOM
RC(J,N)	CURVE FIT CONSTANT FOR THERMODYNAMIC DATA (THE QUANTITY F3 DISCUSSED IN GROUP 12 OF INPUT INSTRUCTIONS), N=1 OR 2 FOR LOW AND HIGH TEMPERATURE RANGES,RESPECTIVELY.	C	EQPCOM
RD(J,N)	CURVE FIT CONSTANT FOR THERMODYNAMIC DATA (THE QUANTITY F4 DISCUSSED IN GROUP 12 OF INPUT INSTRUCTIONS), N=1 OR 2 FOR LOW AND HIGH TEMPERATURE RANGES,RESPECTIVELY.	C	EQPCOM
RE(J,N)	CURVE FIT CONSTANT FOR THERMODYNAMIC DATA (THE QUANTITY F5 DISCUSSED IN GROUP 12 OF INPUT INSTRUCTIONS), N=1 OR 2 FOR LOW AND HIGH TEMPERATURE RANGES,RESPECTIVELY.	C	EQPCOM
RED	REYNOLDS NUMBER ON DEL WHERE DEL IS THE Y DIMENSION NORMAL-IZING PARAMETER. ALSO, RED=VMUE(L)/ALPHASTAR WHERE ALPHA-STAR IS THE FLUX NORMALIZING PARAMETER DEFINED BY EQ. 44 OF NASA CR 1062.	C	EPSCOM
REF2	LOCALLY DEFINED VARIABLE	L	OUTPUT
REF3	LOCALLY DEFINED VARIABLE	L	OUTPUT
REF4	LOCALLY DEFINED VARIABLE	L	OUTPUT
REG2	LOCALLY DEFINED VARIABLE	L	OUTPUT
REG3	LOCALLY DEFINED VARIABLE	L	OUTPUT
RERAD	RADIATION FLUX FROM WALL	L	OUTPUT
RES	REYNOLDS NUMBER BASED 0 DISTANCE S.	C	OUTCOM
RETA	LOCALLY DEFINED VARIABLE	L	OUTPUT
RETHMO	REYNOLDS NUMBER ON MOMENTUM THICKNESS	L	OUTPUT
RETR	TRANSITION REYNOLDS NUMBER BASED ON MOMENTUM THICKNESS.	C	EPSCOM
RF(J,N)	CURVE FIT CONSTANT FOR THERMODYNAMIC DATA (THE QUANTITY F6 DISCUSSED IN GROUP 12 OF INPUT INSTRUCTIONS), N=1 OR 2 FOR LOW AND HIGH TEMPERATURE RANGES,RESPECTIVELY.	C	EQPCOM
RHO(I)	DENSITY OF GAS MIXTURE.	C	PRPCOM
RHOE(L)	DENSITY OF BOUNDARY-LAYER EDGE GAS.	C	EDGCOM
RHOP(I)	DERIVATIVE OF RHO WITH RESPECT TO ETA.	C	PRPCOM
RHOVS	-RHOVW(L,1)/ALPHASTAR. SEE NASA CR 1062 FOR ALPHASTAR.	C	EPSCOM
RHOVW(L,1)	CONVERGED VALUE FOR SURFACE ABLATION RATE.	C	WALCOM
RHR	DENSITY.	L	EQUIL
RI	LOCALLY DEFINED VARIABLE	L	TRMBL

RMMG	RATIO OF MOLECULAR WEIGHT OBTAINED BY SUMMING PARTIAL PRES- SURES OVER ALL SPECIES TO THE MOLECULAR WEIGHT OBTAINED BY SUMMING OVER GAS PHASE SPECIES ONLY.	C EQTCOM
RMMGS	RMMG*RMMG	L MATER
RMU(K,MK)	STOICHIOMETRIC REACTANT COEFFICIENT ON K TH BASE SPECIES.	C KINCOM
RNOSE	EFFECTIVE NOSE RADIUS.	C PRMCOM
ROKAP(L)	1 FOR PLANAR BODIES AND LOCAL BODY RADIUS FOR AXISYMMETRIC BODIES.	C PRMCOM
RR	DENSITY RATIO	L TRMBL
RRFD	LOCALLY DEFINED VARIABLE	L TRMBL
RRP	LOCALLY DEFINED VARIABLE	L TRMBL
RRPD	LOCALLY DEFINED VARIABLE	L TRMBL
RSIG(MK)	RELATIVE SIGNIFICANCE OF KINETIC REACTION IN MASS BALANCE.	C KINCOM
RSQA	RMMGS*FFF/AA	L MATER
RT	PERFECT GAS CONSTANT, R, TIMES TEMPERATURE, T.	L KINET
S(L)	STREAMWISE COORDINATE ALONG BODY.	C PRMCOM
S(N)	LARGEST CONTRIBUTION TO TERM IN N TH COLUMN.	L RERAY
SALPH	SIGNED VALUE OF ALPH	L TRMBL
SB(J)	ENTROPY.	C EQTCOM
SC(I)	REFERENCE SCHMIDT NUMBER, SEE EQ(46) OF NASA CR-1062.	C PRPCOM
SCT	TURBULENT SCHMIDT NUMBER	C EPSCOM
SD(N)	RATIO OF RESIDUAL TERM IN N TH COLUMN TO S(N).	L RERAY
SDUM1(L)	VARIABLE OF INTEGRATION IN CALCULATION OF XI IN REFCON, TEM- PORARY STORAGE AREA IN OTHER ROUTINES.	C TEMCOM
SDUM2(L)	VARIABLE OF INTEGRATION IN CALCULATION OF FW IN REFCON, TEM- PORARY STORAGE AREA IN OTHER ROUTINES.	C TEMCOM
SDY	LOCALLY DEFINED VARIABLE	L TRMBL
SHAPE	DELST/THMOM, SHAPE FACTOR.	C OUTCOM
SHEAR	WALL SHEAR GIVEN BY CAPC(1)/ALPH * VMUE(IS) * UE(IS)/C89 * F(3,1)/32.1740	C OUTCOM
SHIP	SAVED VALUE OF INPUT ENTHALPY.	L EQUIL

SHMELT	ENTHALPY OR ENTROPY OF FUSION OF A SPECIES IF TEMPERATURE EQUALS FUSION TEMPERATURE OF THAT SPECIES.	L MATER
SIGMA	COLLISION CROSS SECTION FOR REFERENCE SPECIES	C EQTCOM
SIP	ENTROPY INPUT.	C EQTCOM
SLAM(K)	DEFINED BY EQ(83) OF NASA CR-1064.	C EQTCOM
SM(J)	ENTROPY OF FUSION.	C EQPCOM
SMELT	SM(J) IF J TH SPECIES IS CHANGING PHASE, OTHERWISE 0.	C EQTCOM
SP(N,I,K)	ELEMENTAL MASS FRACTION (N=1) AND ITS DERIVATIVES OF ORDER N-1 WITH RESPECT TO ETA.	C VARCOM
SPEASE	SAVED VALUE OF PIEASE	L EQUIL
SPD(N)	D1 * SP(N,I,K) * D2 * HSP(I,N,K) FOR N=1 THROUGH 3, D1 * SP(3,I-1,K) * D2 * HSP(I-1,3,K) FOR N=4.	L HISTXI
SPDUM(K)	DIMENSIONED VARIABLE USED IN VARIOUS SUBROUTINES BUT NOT USED FOR TRANSMITTING INFORMATION BETWEEN SUBROUTINES.	C TEMCOM
SPE(K,L,1)	ELEMENTAL MASS FRACTION AT BOUNDARY LAYER EDGE.	C EDGCOM
SPLE(N,K)	ERROR FOR THE TAYLOR SERIES EXPANSIONS INVOLVING SP(1,I,K) AND THEIR DERIVATIVES.	C ERRCOM
SPLEM(K)	MAXIMUM VALUE OF SPLE(N,K).	C ERRCOM
SPNEW	VARIABLE USED TO DENOTE PRESENCE OF NEW ELEMENT IN SYSTEM	L RNLCER
SPNEW	VARIABLE USED TO DENOTE PRESENCE OF NEW ELEMENT IN SYSTEM	L NONCER
SPNLEM(K)	ERROR FOR THE LINEARIZED ELEMENTAL CONSERVATION EQUATIONS.	C ERRCOM
SPW(K,L,1)	CONVERGED VALUE FOR ELEMENTAL MASS FRACTION OF BOUNDARY LAYER GAS AT THE WALL.	C WALCOM
SS	LOCALLY DEFINED VARIABLE	L SLOPQ
SSIP	SAVED VALUE OF INPUT ENTROPY.	L EQUIL
SSTAG	STAGNATION ENTROPY BASED ON 1 ATM PRESSURE.	L STATE
SSTAGA	STAGNATION ENTROPY BASED ON ACTUAL PRESSURE.	L STATE
STEF	STEFAN-BOLTZMANN CONSTANT.	C CRBCOM
STTEQV	VARIABLE EQUIVALENCED TO STTCOM FOR DUMPING PURPOSES	L DUMCOM
SUMD	RT*D LOG KP/D LOG T OF KINETIC REACTION.	L KINET
SUMG	OFF-DIAGONAL COLUMN SUMS OF GAMK USED TO STRENGTHEN DIAGONAL DOMINANCE OF ARRAY.	L EQUIL

SUMK	LOG KP OF KINETIC REACTION.	L KINET
SUML	LOG (SUMN/P)	C EQTCOM
SUMN	SUMMATION OF PARTIAL PRESSURES FOR ALL GAS PHASE SPECIES.	C EQTCOM
SUMP	SUM OF PRODUCT Y(N).	L KINET
SUMR	SUM OF REACTANT Y(N).	L KINET
T	STATIC TEMPERATURE IN DEG K, IDENTICAL TO Z+.	C EQPCOM
T(I)	STATIC TEMPERATURE IN DEG R, IDENTICAL TO TT*.	C PRPCOM
TAU(K,KK)	INTERMEDIATE ARRAY USED IN FORMING UM.	L INPUT
TC(J)	-D LOG KP / D LOG T FOR FORMATION REACTION OF J TH SPECIES.	C EQTCOM
TCW	TC EVALUATED AT THE WALL FOR THE (ISP)TH ELEMENT.	C NONCOM
TDSIP(N)	TEMPORARY STORAGE FOR DSIP(L) DURING TAPE FLIP-FLOP FOR N = 1 AND 2.	C
TE(L)	TEMPERATURE AT BOUNDARY LAYER EDGE.	C EDGCOM
TEMEQV	VARIABLE EQUIVALENCED TO TEMCOM FOR DUMPING PURPOSES	L DUMCOM
TF(J)	FAIL TEMPERATURE OF SPECIES J.	E EQPCOM
TFMAX	MAXIMUM FAIL TEMPERATURE OF CANDIDATE SURFACE SPECIES.	L INPUT
TFZ	SURFACE TEMPERATURE TO WHICH CONVERGENCE IS TEMPORARILY AT-TEMPTED DURING ENERGY BALANCE PROBLEMS USING KR(9)=6.	C BUMCOM
THCOND	ENTHALPY THICKNESS	L OUTPUT
THELEM(K)	MASS THICKNESSES GIVEN BY DUZ(K)/DUM(K) WHERE DUZ(K) IS THE SUMMATION OVER KK OF C89/ALPH * ((F(1,NETA)-F(1,1)) * SP(1,NETA,KK)-XSP(5,KK))/ WTM(KK) * CIJ(K,KK) AND DUM(K) IS THE SUMMATION OVER KK OF (SP(1,NETA,KK)-SP(1,1,KK)/WTM(KK) * CIJ(K,KK).	L OUTPUT
THENGY	ENERGY THICKNESS GIVEN BY C89/ALPH * ((F(1,NETA)-F(1,1)) * G(1,NETA)-XG(5))/(G(1,NETA)-G(1,1)).	C OUTCOM
THF(I,N)	TEMPORARY STORAGE FOR HF(I,5) DURING TAPE FLIP-FLOP FOR N = 1 AND 2.	C
THMOM	MOMENTUM THICKNESS GIVEN BY C89/ALPH * ((F(1,NETA)-F(1,1)) -XM(5)/ALPH).	C OUTCOM
TIMD	REAL ELAPSED TIME SINCE BEGINNING OF SOLUTION	L ITERAT
TIME(M)	TIME(OR SUBCASE).	C PRMCOM
TION	TEMPERATURE BELOW WHICH IONIZATION WILL BE SUPPRESSED	L EQUIL

TK(K,N)	GRAM ATOMS OF ELEMENT K PER UNIT MASS OF COMPONENT N.	C EQPCOM
TM	MAXIMUM OR MINIMUM TEMPERATURE IF DELTA T IS POSITIVE OR NEGATIVE, RESPECTIVELY.	L CRECT
TMAT(NN,N)	TEMPORARY STORAGE FOR VMAT(NN) DURING TAPE FLIP-FLOP FOR N = 1 AND 2.	C
TMAX	MAXIMUM TEMPERATURE ALLOWED FOR CURRENT ITERATION.	C EQTCOM
TMIN	MINIMUM TEMPERATURE ALLOWED FOR CURRENT ITERATION.	C EQTCOM
TMU3	VN(J) / FF(J) SUMMED OVER ALL SPECIES N*, (=VMU3 * VMU2 * P).	L PROPS
TP	DERIVATIVE OF T WITH RESPECT TO ETA.	C PRPCOM
TPE(N)	TEMPORARY STORAGE FOR PE(L,1) DURING TAPE FLIP-FLOP FOR N = 1 AND 2.	C
TQ(K,N)	GRAM ATOMS OF BASE SPECIES K PER UNIT MASS OF COMPONENT N. (SEE W(N) FOR DEFINITION OF COMPONENTS).	C EQPCOM
TRADS(N)	TEMPORARY STORAGE FOR RADS(L) DURING TAPE FLIP-FLOP FOR N = 1 AND 2.	C
TREF	GROUP OF TERMS WHICH APPEARS IN DERIVATIVES OF PI. (REYNOLDS NUMBER ON DELST)/C26/(2.*CAPC(I)**2*YAP**2*PI).	C EPSCOM
TRHOE(N)	TEMPORARY STORAGE FOR RHOE(L) DURING TAPE FLIP-FLOP FOR N = 1 AND 2.	C
TS	PHASE CHANGE TEMPERATURE.	L INPUT
TT(I)	STATIC TEMPERATURE IN DEG R, IDENTICAL TO T+.	C PRPCOM
TTE(N)	TEMPORARY STORAGE FOR TE(L) DURING TAPE FLIP-FLOP FOR N = 1 AND 2.	C
TTMAX	MAXIMUM TEMPERATURE ALLOWED FOR THIS SOLUTION.	C EQTCOM
TTMIN	MINIMUM TEMPERATURE ALLOWED FOR THIS SOLUTION.	C EQTCOM
TTVC	VARIABLE T USED IN TRANSVERSE CURVATURE CALCULATIONS	C EDGCOM
TU(J,N)	UPPER TEMPERATURE OF TEMPERATURE RANGE FOR INPUTTING THERMO DYNAMIC PROPERTY DATA FOR SPECIES J, N=1 OR 2 FOR LOWER AND UPPER TEMPERATURE RANGES, RESPECTIVELY.	C EQPCOM
TUE(N)	TEMPORARY STORAGE FOR UE(L) DURING TAPE FLIP-FLOP FOR N= 1 AND 2.	C
TVCC(IS)	CONSTANT USED IN TVC CALCULATIONS	C EDGCOM
TVMUE(N)	TEMPORARY STORAGE FOR VMUE(L) DURING TAPE FLIP-FLOP FOR N = 1 AND 2.	C

TW(L,1)	CONVERGED VALUE OF SURFACE TEMPERATURE.	C	WALCOM
TXI(N)	TEMPORARY STORAGE FOR XI(L) DURING TAPE FLIP-FLOP FOR N= 1C AND 2.		
UE(L)	BOUNDARY-LAYER EDGE VELOCITY.	C	EDGCOM
UEDGE	PARAMETER ENTERING INTO ENTROPY LAYER OPTION, SEE EQ(68) OF NASA CR-1062 (SET EQUAL TO UNITY IN PRESENT PROGRAM).	C	EDGCOM
UGH	NORMALIZING FACTOR IN GAUSSIAN ELIMINATION.	L	INPUT
UKAP	EDGE VELOCITY NORMALIZED BY REFERENCE VELOCITY	L	NONCER
UM(K,KK)	MOLECULES OF BASE SPECIES K IN ELEMENT KK.	L	INPUT
UNIT(N)	COMPLEX FACTOR HAVING TO DO WITH DAMPING OF KINETICALLY CONTROLLED MASS BALANCES.	C	KINCOM
UNIT(N)	SMOOTHING FACTOR RELATED TO IMPOSING RESIDUAL ERROR INTO REACTIVE MASS BALANCES AS A RESULT OF BOUNDARY LAYER DAMPING.	L	KINET
V	LOCALLY DEFINED VARIABLE	L	INPUT
VA	LOCALLY DEFINED VARIABLE	L	CRECT
VA	LOCALLY DEFINED VARIABLE	L	INPUT
VA	LOCALLY DEFINED VARIABLE	L	MATER
VA	LOCALLY DEFINED VARIABLE	L	PROPS
VA	LOCALLY DEFINED VARIABLE	L	THERM
VAREQV	VARIABLE EQUIVALENCED TO VARCOM FOR DUMPING PURPOSED	L	DUMCOM
VB	LOCALLY DEFINED VARIABLES	L	INPUT
VB	LOCALLY DEFINED VARIABLES	L	PROPS
VB	LOCALLY DEFINED VARIABLES	L	THERM
VC	LOCALLY DEFINED VARIABLES	L	INPUT
VC	LOCALLY DEFINED VARIABLES	L	PROPS
VC	LOCALLY DEFINED VARIABLES	L	THERM
VD	LOCALLY DEFINED VARIABLES	L	INPUT
VD	LOCALLY DEFINED VARIABLES	L	THERM
VE	LOCALLY DEFINED VARIABLES	L	INPUT
VE	LOCALLY DEFINED VARIABLES	L	THERM

VEL	VELOCITY.	L EQUIL
VELSQ	SQUARE OF VELOCITY.	L EQUIL
VINT	P * 10**(-6)	L INPUT
VJKW(K)	DIFFUSIVE MASS FLUX OF BASE SPECIES AT THE WALL, CK6(K)/C3 EVALUATED AT THE WALL (IN OUTPUT, VJKW(K) IS MODIFIED TO REPRESENT DIFFUSIVE MASS FLUXES OF ELEMENTS AT THE WALL(.	C FLXCOM
VK(K)	SP(1,I,K)	L PROPS
VKAP	FLAG FOR BODY SHAPE (0 FOR PLANAR, 1 FOR AXISYMMETRIC).	C PRMCOM
VK1	LOCALLY DEFINED VARIABLES	L KINET
VK2	LOCALLY DEFINED VARIABLES	L KINET
VK3	LOCALLY DEFINED VARIABLES	L KINET
VLAM	MIXTURE THERMAL CONDUCTIVITY GIVEN BY RHO(I) * DBAR * VMU6 * 1.9869 / (WM * VMU1).	L PROPS
VLAM(J,K)	LAMBDA,DEFINED IN EQ(83) OF NASA CR-1064.	E NONCOM
VLNK(J)	LOG KP FOR FORMATION REACTION OF J TH SPECIES.	C EQTCOM
VLNKW	VLNK EVALUATED AT THE WALL FOR THE (ISP)TH ELEMENT.	C NONCOM
VMACH	MACH NUMBER	L EQUIL
VMACH	MACH NUMBER.	L STATE
VMAT(N)	SET OF VARIABLES STARTING WITH C1 TO BE STORED ON TAPE.	E HISCOM
VMECH	SURFACE MASS LOSS RATE DUE TO LIQUID LAYER FLOW	L OUTPUT
VMU(I)	VISCOSITY OF MIXTURE, COMPUTED IN SUBROUTINE PROPS AS RHO (I)*DBAR*VMU5/VMU1.	C PRPCOM
VMU1	COEFFICIENT MU1 DEFINED IN EQ(22) OF NASA CR-1062.	L PROPS
VMU2	SAME AS VMU2 IN PROPS.	L MATER
VMU2	COEFFICIENT MU2 DEFINED IN EQ(22) OF NASA CR-1062.	L PROPS
VMU3	PROPERTY OF THE GAS MIXTURE WHICH REDUCES TO 1/WM FOR EQUAL DIFFUSION COEFFICIENTS, SEE EQ(28) OF NASA CR-1062.	C PRPCOM
VMU3P	DERIVATIVE OF VMU3 WITH RESPECT TO ETA.	C PRPCOM
VMU4P	DERIVATIVE OF VMU4 WITH RESPECT TO ETA.	C PRPCOM
VMU5	CONTRIBUTION TO MIXTURE VISCOSITY GIVEN BY AMU5 * RMMG/AA.	L PROPS

VMU6	CONTRIBUTION TO MIXTURE THERMAL CONDUCTIVITY GIVEN BY (PMU6L + CPTIL/1.9869-2.5 * TMU3) / P.	PROPS
VMU12	PRODUCT OF THE TWO COEFFICIENTS MU1 AND MU2 DEFINED IN EQ (22) OF NASA CR-1062.	C PRPCOM
VMUA	CONSTANT IN THE VISCOSITY RELATION MU=(VMUA*T**VMUB)/(VMUC.T+VMUD), USED IN KR(7)= 1 OPTION ONLY.	C STTCOM
VMUB	CONSTANT IN THE VISCOSITY RELATION DEFINED UNDER VMUA.	C STTCOM
VMUC	CONSTANT IN THE VISCOSITY RELATION DEFINED UNDER VMUA.	C STTCOM
VMUD	CONSTANT IN THE VISCOSITY RELATION DEFINED UNDER VMUA.	C STTCOM
VMUE(L)	VISCOSITY AT BOUNDARY LAYER EDGE.	C EDGCOM
VMW(I)	MOLECULAR WEIGHT OF THE MIXTURE.	C PRPCOM
VMWE	MOLECULAR WEIGHT OF GAS AT BOUNDARY LAYER EDGE.	C EDGCOM
VN(J)	PARTIAL PRESSURE.	C EQPCOM
VNU(J,K)	STOICHIOMETRIC COEFFICIENT ON K TH BASE SPECIES IN FORMATION OF J TH SPECIES.	C EQPCOM
VVOL	LOCALLY DEFINED VARIABLE	L REFCON
W(N)	COMPONENT MASS FLUX AT WALL, W(1) IS EDGE GAS, W(2) IS PYROLYSIS GAS, W(3) IS CHAR.	C BLQCOM
WALEQV	VARIABLE EQUIVALENCED TO WALCOM FOR DUMPING PURPOSES	L DUMCOM
WALLJ(K)	NORMALIZED DIFFUSIVE MASS FLUX AT WALL (DEFINED BY EQ(48) OF NASA CR-1062), CK6(K) EVALUATED AT THE WALL.	C FLXCOM
WALLQ	NORMALIZED DIFFUSIVE HEAT FLUX AT THE WALL (DEFINED BY EQ (50) OF NASA CR-1062), C32 EVALUATED AT THE WALL.	C FLXCOM
WALLQJ(N)	GLOBAL SET OF WALLQ AND WALLJ.	E FLXCOM
WAT(K)	ATOMIC WEIGHT.	C EQPCOM
WD2	1.2 * AISTAR / PMU1	L PROPS
WD4	0.284 * WDZ	L PROPS
WD5	0.32 * AISTAR / PMU1	L PROPS
WD7	WDZ/PMU1 - WD2	L PROPS
WD8	WD4/PMU1-WD5	L PROPS
WDOT	ABLATION RATE IN THE CONVERGED SOLUTION OF MATERIAL CONSIDERED UNDER KR(9)= 3 THROUGH 6.	C BUMCOM

WDZ	CONSTANT 1.385 WHICH ENTERS INTO CALCULATION OF MIXTURE TRANSPORT PROPERTIES.	L PROPS
WM	MOLECULAR WEIGHT OF MIXTURE.	C EQPCOM
WS	SUM OF PYROLYSIS AND CHAR MASS RATES.	L MATER
WSUM	W(1) + W(2) + W(3)	L NONCER
WT	MOLECULAR WEIGHT AS SUMMED.	L INPUT
WTG	PRESSURE * GAS MOLECULAR WEIGHT.	L MATER
WTL	SUMMATION OF VN(J) * WTM(J) FOR ALL CONDENSED SPECIES.	L MATER
WTM(J)	MOLECULAR WEIGHT OF SPECIES J.	C EQPCOM
X(N)	CORRECTIONS OF NONLINEAR VARIABLES IN CHEMISTRY SOLUTION.	E EQTCOM
X1	DAMPED VALUE OF DELTA LN T.	L CRECT
XD	LOCALLY DEFINED VARIABLE	L SLOPQ
XG(N)	DEFINED BY EQ(86) OF NASA CR-1062 EVALUATED FOR P=G(1,I), N= 1 TO 4. XG(5) IS THE INTEGRAL OF (F(2,I)*G(1,I)*DETA) GIVEN BY EQ (85).	C COECON
XI(L)	TRANSFORMED STREAMWISE COORDINATE DEFINED BY EQS(31) AND (33) OF NASA CR-1062.	C HISCOM
XICON(L)	INTEGRAND IN CALCULATION OF XI IN REFCON, TEMPORARY STORAGE AREA IN OTHER ROUTINES.	C TEMCOM
XJ	LOCALLY DEFINED VARIABLE	L MATS1
XK	LOCALLY DEFINED VARIABLE	L MATS1
XKP	LOCALLY DEFINED VARIABLE	L MATS1
XM(N)	DEFINED BY EQ(86) OF NASA CR-1062 EVALUATED FOR P=F(2,I), N= 1 TO 4, XM(5) IS THE INTEGRAL OF (F(2,I)*F(2,I)*DETA) GIVEN BY EQ(85).	C COECON
XOT	LOCALLY DEFINED VARIABLE	L SLOPQ
XOTT	LOCALLY DEFINED VARIABLE	L SLOPQ
XS	LOCALLY DEFINED VARIABLE	L MATS1
XSP(N,K)	DEFINED BY EQ(86) OF NASA CR-1062 EVALUATED FOR P=SP(1,I,K) N=1 TO 4. XSP(5,K) IS THE INTEGRAL OF (F(2,I)*SP(1,I,K) *DETA) GIVEN BY EQ(85).	C COECON
XT	LOCALLY DEFINED VARIABLE	L ABMAX

XTO	LOCALLY DEFINED VARIABLE	L SLOPQ
XTT	LOCALLY DEFINED VARIABLE	L SLOPQ
Y(I)	ACTUAL DISTANCE FROM BODY MEASURED NORMAL TO SURFACE.	C OUTCOM
Y(J)	NATURAL LOG OF PARTIAL PRESSURE (=0 FOR PRESENT CONDENSED SPECIES), IDENTICAL TO YYY(J)+.	C EQPCOM
YAP	CONSTANT IN MIXING LENGTH EQUATION.	C EPSCOM
YC	INITIAL VALUE OF Y(J).	L INPUT
YDI	LOCALLY DEFINED VARIABLE	L TRMBL
YDIQ	LOCALLY DEFINED VARIABLE	L TRMBL
YDQD	LOCALLY DEFINED VARIABLE	L TRMBL
YDS	LOCALLY DEFINED VARIABLE	L TRMBL
YINT	ALOG(VINT)	L INPUT
YS	LOCALLY DEFINED VARIABLE	L SLOPQ
YW(K)	VALUE OF YYY(J) AT WALL (SAVED).	C EQPCOM
Z	STATIC TEMPERATURE IN DEG K, IDENTICAL TO T*.	C EQPCOM
ZG(N,I)	DEFINED BY EQ(94) OF NASA CR-1062 EVALUATED FOR P=G(1,I), N = 1 TO 4.	C HISCOM
ZK(K)	QUANTITY FOR ELEMENT K WHICH IS INTRODUCED AS A RESULT OF THE APPROXIMATION FOR BINARY DIFFUSION COEFFICIENTS AND REDUCES TO SP(1,I,K) FOR EQUAL DIFFUSION COEFFICIENTS (SEE EQ(25) OF NASA CR-1062).	C PRPCOM
ZKP(K)	DERIVATIVE OF ZK WITH RESPECT TO ETA.	C PRPCOM
ZM(N,I)	DEFINED BY EQ(94) OF NASA CR-1062 EVALUATED FOR P=F(2,I), N = 1 TO 4.	C HISCOM
ZSP(N,I,K)	DEFINED BY EQ(94) OF NASA CR-1062 EVALUATED FOR P=SP(1,I,K) N = 1 TO 4.	C HISCOM

APPENDIX I

WALL BOUNDARY CONDITIONS

Wall boundary conditions for the BLIMP program have been generalized to include surface thermochemistry considerations since a large proportion of the problems on which BLIMP is used include ablating surfaces. These wall boundary conditions are flagged by various combinations of the KR(9) and KR(11) flags. The purpose of this appendix is to explain the types of options that are available.

For typical engineering problems, there are several sets of boundary conditions which are used most often. These are typically combinations of the following conditions.

- o Chemical equilibrium between the gaseous boundary layer and the surface material
- o Assigned surface temperature
- o Assigned surface mass flux
- o Energy balance between the surface material and the gaseous boundary layer assuming steady state ablation.

Of course, these four conditions cannot be used in all possible combinations and do not constitute a complete list Five combinations which can be used in the BLIMP program and the control card punches necessary to flag them are summarized below. A more general discussion is contained in reference 1. The reader should also note that a procedure for varying KR(9) as a function of body station (denoted KR9( ) in this manual) is described under card 3, field 2 of group 3. This procedure allows the user to change the type of boundary conditions at various points along the body.

a. Assigned temperature and mass flux

Use KR(9) = 2, KR(11) = 0. This combination is often used when experimental data or data from separate analyses are available to describe T and MDOT as functions of streamwise location. No surface material-boundary layer gas interaction chemistry is considered in the resulting solutions.

b. Assigned temperature and surface equilibrium

Use KR(9) = 2, KR(11) = 0. This option is obtained when the program compares the assigned temperature to the ablation temperature

(group 11, card 1) for the surface material in question. If the assigned temperature is larger, a surface equilibrium analysis is performed. The assigned MDOT should be zero.

With the surface equilibrium chemistry package called in, the program automatically chooses the correct surface material and calculates the correct mass loss rate at the assigned temperature. Surface kinetics and fail temperatures (e.g., for a melting material) may also be used with this option.

c. Assigned mass flux and surface equilibrium

Use KR(9) = 2, KR(11) = 2. This option also uses the surface equilibrium chemistry package mentioned in (b) above. The program will automatically choose the correct surface material and temperature to coincide with the assigned mass flux. Kinetics and fail temperatures can be used.

d. Steady state energy balance and surface equilibrium

Use KR(9) = 4, KR(11) = 0. Whenever KR(9) is greater than or equal to 3, a special surface chemistry package based on vapor pressures is called (see reference 3). The special chemistry package does not allow fail temperatures or kinetic control of reactions, and the surface material must be specified in advance. Within these limitations, the program will calculate the correct mass loss rate of specified surface material necessary to satisfy the steady state energy balance equation.

In the steady state energy balance, the pyrolysis front and the exposed material surface are assumed to be receding at identical rates. This special situation eliminates the need for an in-depth conduction analysis (see references 9 and 10) and allows ablation calculations to be performed as a subroutine to the boundary layer analysis. The steady state assumption is good for large ablation rates or small thermal diffusivity of the ablation material (reference 11). For charring materials it is also necessary that the ratio of pyrolysis gas to char mass removal rate approach the steady state ratio, which can be found from the virgin material composition.

e. Assigned flux of transpirant with steady state energy balance

Use KR(9) = 2, KR(11) = 0, and assign KR9( ) = 4, as required. This option allows an assigned flux of transpiring gas into the boundary layer through an ablating surface while maintaining surface equilibrium. The local surface condition is determined by the steady state energy balance. The flux of transpirant gas is input on card set 11

of group 16 as a pyrolysis gas. The fields for boundary layer edge gas and char fluxes must also be input in accordance with KR(9) = 2 but blank cards may be used. Card set 3 of group 16 for assigned wall temperature is also required in accordance with KR(11) = 0 but blank fields may be used. The boundary layer calculations use the KR9( ) = 4 value, the KR(9) = 2 option affecting only the reading of the transpiration flux. The heat of formation of the transpirant gas must be input in field 3 of card 1 of group 6.

The above combinations of boundary conditions are used in nearly all ablating and nonablating boundary layer flow analyses, however other combinations are possible. For example, for program checkout purposes it is sometimes useful to specify elemental mass fraction together with stream function or mass fluxes at the wall (KR(9) = 0 or 1). This option is meaningless for unequal diffusion problems since the elemental mass fractions at the wall are not known in advance.

APPENDIX II

Table I

FORCE CONSTANTS FROM REFERENCE 6

Molecule	σ	ε/k
Al	2.655	2750
AlCl	3.578	932
$AlCl_3$	5.127	472
AlF	3.140	556
AlF_3	4.198	1846
AlN	3.369	2682
AlO	3.204	542
AlS	3.730	1526
Al_2	2.940	2750
Air	3.711	78.6
Ar	3.542	93.3
AsH_3	4.145	259.8
B	2.265	3331
BBr_3	5.439	430
BCl	3.318	1026
BCl_2	[illegible]	682
BCl_3	5.127	337.7
BF	[illegible]	412
BF_2	3.548	399
BF_3	4.198	186.3
BI_3	5.908	570.2
BO	2.944	596
$B(OCH_3)_3$	5.503	396.7
B_2	[illegible]	3331
B_2H_6	4.821	213.2
B_2O_3	4.158	2092
Be	2.610	3403
$BeBr_2$	[illegible]	936
BeCl	[illegible]	1067
$BeCl_2$	[illegible]	936
BeF	3.124	637
BeF_2	3.452	1266
BeI_2	4.966	1019
Be_2	2.891	3403
Br	3.672	236.6
BrF	[illegible]	239
BrF_3	4.366	481.7
BrO	[illegible]	233
Br_2	4.296	507.9
C	[illegible]	30.6
$CBrF_3$	5.01	235
CBr_4	6.12	442
CCl	4.068	157.8
$CClF_3$	4.96	188
CCl_2	4.692	213
CCl_2F_2	5.25	253
CCl_3	5.320	268
CCl_3F	5.44	334
CCl_4	5.947	322.7
CF	3.638	94.2
CF_2	3.977	108
CF_3	4.320	121
CF_4	4.662	134.0
CH	3.370	68.6
CHBrClF	5.13	345
$CHBrCl_2$	5.25	427
$CHBr_3$	5.33	559
$CHClF_2$	4.68	261
$CHCl_3$	5.389	340.2
CHF_3	4.33	240
CH_2BrCl	4.88	410
CH_2ClF	4.48	318
CH_2Cl_2	4.898	356.3
CH_2F_2	4.08	318
CH_2I_2	5.16	630
CH_3Br	4.118	449.2
CH_3Cl	4.182	350
CH_3F	3.78	333
CH_3I	4.23	619
CH_3OH	3.626	481.8
CH_4	3.758	148.6
CN	3.856	75.0
CO	3.690	91.7
COS	4.130	336.0
CO_2	3.941	195.2
CP	4.400	227
CS	4.216	199.4
CS_2	4.483	467
C_2	3.913	78.8
C_2H_2	4.033	231.8
C_2H_4	4.163	224.7
C_2H_6	4.443	215.7
C_2H_5Cl	4.898	300
C_2H_5OH	4.530	362.6
C_2N_2	4.361	348.6
CH_3OCH_3	4.307	395.0
CH_2CHCH_3	4.678	298.9
CH_3CCH	4.761	251.8
cyclo-C_3H_6	4.807	248.9
C_3H_8	5.118	237.1
n-C_3H_7OH	4.549	576.7
CH_3COCH_3	4.600	560.2
CH_3COOCH_3	4.936	469.8
n-C_4H_{10}	4.687	531.4
iso-C_4H_{10}	5.278	330.1
$C_2H_5OC_2H_5$	5.678	313.8
$CH_3COOC_2H_5$	5.206	521.3
n-C_5H_{12}	5.784	341.1
$C(CH_3)_4$	6.464	193.4
C_6H_6	5.349	412.3
C_6H_{12}	6.182	297.1
n-C_6H_{14}	5.949	399.3
Cd	2.606	1227
Cl	3.613	130.8
ClCN	4.047	338.7
ClF	[illegible]	203.4
ClF_3	[illegible]	335.7
ClO	3.842	184
Cl_2	4.217	316.0
F	2.968	112.6
FCN	3.378	168
F_2	3.357	112.6
H	2.708	37.0
HBr	3.353	449
HCN	3.630	569.1
HCl	3.339	344.7
HF	3.148	330
HI	4.211	288.7
HS	3.673	86.4
H_2	2.827	59.7
H_2O	2.641	809.1
H_2O_2	4.196	289.3
H_2S	3.623	301.1
He	2.551	10.22
Hg	2.969	750
$HgBr_2$	5.080	686.2
$HgCl_2$	4.550	750
HgI_2	5.626	695.6
I	5.380	210.7
ICl	4.688	437.3
I_2	5.160	474.2
Kr	3.655	178.9
Li	2.850	1899
LiBr	3.748	1815
LiCN	[illegible]	569.1
LiCl	3.708	1919
LiF	3.278	2305
LiI	4.180	1728
LiO	3.334	450
Li_2	3.200	1899
Li_2O	3.561	1827
Mg	2.926	1614
MgCl	3.759	714
$MgCl_2$	4.340	[illegible]
MgF	3.389	[illegible]
MgF_2	3.623	[illegible]
Mg_2	3.301	1614
N	3.298	71.4
NF_3	4.154	175
NH	3.312	65.3
NH_3	2.900	558.3
NO	3.492	116.7
NOCl	4.112	395.3
N_2	3.798	71.4
N_2O	3.828	232.4
Na	3.567	1375
NaBr	[illegible]	[illegible]
NaCN	[illegible]	[illegible]
NaCl	4.186	[illegible]
NaF	3.754	[illegible]
NaI	[illegible]	[illegible]
NaO	3.012	[illegible]
NaOH	[illegible]	[illegible]
Na_2	4.156	1375
Na_2O	[illegible]	1827
Ne	[illegible]	[illegible]
O	[illegible]	[illegible]
OF	3.412	[illegible]
OF_2	3.878	161
OH	3.147	79.8
O_2	3.467	[illegible]
P	4.115	[illegible]
PCl	[illegible]	[illegible]
PCl_3	[illegible]	419
PF	[illegible]	[illegible]
PF_3	[illegible]	[illegible]
PH_3	[illegible]	[illegible]
PN	[illegible]	[illegible]
PO	4.177	[illegible]
PS	4.703	744
P_2	[illegible]	[illegible]
P_4	[illegible]	711
S	[illegible]	847
SF_6	[illegible]	[illegible]
SO	[illegible]	[illegible]
SO_2	4.112	[illegible]
S_2	4.219	847
S_2F_2	[illegible]	[illegible]
Si	2.910	[illegible]
SiCl	3.768	[illegible]
$SiCl_4$	5.977	[illegible]
SiF	[illegible]	[illegible]
$SiFCl_3$	5.640	[illegible]
SiF_2Cl_2	5.270	277
SiF_3Cl	4.975	[illegible]
SiF_4	[illegible]	171.9
SiH_4	[illegible]	[illegible]
SiO	3.374	[illegible]
SiO_2	3.706	[illegible]
SiS	3.900	[illegible]
Si_2	[illegible]	[illegible]
$SnBr_4$	[illegible]	[illegible]
$SnCl_4$	[illegible]	[illegible]
UF_6	5.967	[illegible]
Xe	4.047	[illegible]
Zn	[illegible]	[illegible]
Ar	[illegible]	119.9
He	[illegible]	10.22
Kr	[illegible]	164.7
Ne	[illegible]	[illegible]
Xe	[illegible]	[illegible]

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13. ABSTRACT

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A complete description of the Boundary Layer Integral Matrix Procedure (BLIMP) computer code is given, including descriptions and explanations of the program input preparation, interpretation of output, special output for debugging purposes, and a list and definitions of the Fortran variables. Three sample problems are included, ranging in complexity from air flow over a flat plate to air flow over an ablating reentry vehicle nosetip and heat shield composed of three different surface materials. A section on changing program dimensions is also included.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Turbulent boundary layer						
viscous flow						
Plasma sheath						
Missile reentry						
Computer program						
Nonsimilar boundary layer						